DOCUMENT RESUME

ED 196 704 SE 033 681

AUTHOR	Bowman, Mary Lynne, Comp.
TITLE	Teaching Basic Skills Through Environmental Education Activities.
INSTITUTION	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Dec 79
CONTRACT	400-78-0004
NOTE	126p.
AVAILABLE FROM	Information Reference Center (ERIC/IRC), The Ohio State University, 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212 ($4.00).
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Basic Skills; *Elementary Secondary Education; *Environmental Education; Instructional Materials; *Language Arts; Mathematics Education; *Mathematics Instruction; Outdoor Education; Reading Skills; Writing Skills

ABSTRACT

Presented are 65 participation-oriented environmental education activities for teaching basic skills in language arts and mathematics. Intended for students in the elementary through high school grades, lessons are classified by grade level and subject area. Each lesson plan describes the purpose, lists required materials, and explains the instructional procedure. Among the skills covered are those related to reading, grammar, creative writing, basic number processes, geometry, and solving word problems. Also provided are references for each activity and a list of publications on other environmental education activities. (WB)

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TEACHING BASIC SKILLS THROUGH ENVIRONMENTAL EDUCATION ACTIVITIES

Selected and developed by

Mary Lynne Bowman

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Foreword by

Robert J. Warpinski

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and Environmental Education
The Ohio State University
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December 1979

SE 033 681

ENVIRONMENTAL EDUCATION INFORMATION REPORTS

Environmental Education Information Reports are issued to analyze and summarize information related to the teaching and learning of environmental education. It is hoped that these reviews will provide information for personnel involved in development, ideas for teachers, and indications of trends in environmental education.

Your comments and suggestions for these publications are invited.

John F. Disinger
Associate Director
Environmental Education

This publication was prepared with funding from the National Institute of Education, U.S. Department of Education under contract no. 400-78-0004. The opinions expressed in this report do not necessarily relfect the positions or policies of NIE or U.S. Department of Education.

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Robert J. Warpinski is Director of Project I-C-E (Instruction- Curriculum-Environment), Green Bay, Wisconsin. Developed under E.S.E.A. Title III, 1970-1975, I-C-E is a concept-based total K-12 environmental education program. With State of Wisconsin and National validation, since 1975 I-C-E has functioned as a part of the U.S. Department of Education's National Diffusion Network, with dissemination efforts in over 20 states and adoptions/adaptations involving more than 100 districts and reaching thousands of teachers.

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FOREWORD

In 1970, when a group of teachers was queried: "What do you need to teach environmentally?", the response was not training, or a cooperative board of education or administration via support monies, but overwhelmingly, "Give us some materials." Today, ten years later, the programs and the materials abound. They range from projects in small school districts to programs supported by federal agencies. The instructional strategies and approaches to these programs are equally as varied--from unique garbage can kits for the classroom to concentration on nature study at an outdoor center. Published and unpublished materials run the gamut, as diverse as this country is diverse. The quantity of that accessed by the Environmental Education sector of ERIC alone is staggering. In other words, for anyone who wishes to take the time, there is an answer now to "give us some materials."

Like the anti-climax of a novel, the '80s are ushering in the anti-climax to environmental education. The late '60s and early '70s saw a tremendous interest in the environment, a concern about its degradation, a concern about the preservation of a quality life, both immediate and for the future, all of which contributed to give environmental education a high priority in the schools across the land. This educational priority peaked between 1973 and 1975, and has waned somewhat each year since. Currently, the interest in environmental education has settled at a level considerably higher than during the pre-1965 era. Unfortunate for the environmental education cause is the surfacing of other priorities, some of which perceive environmental education as taking time away from the basics. What could possibly be more basic than the environment upon which we depend for life itself? Additionally, the motivational aspects of good environmental education might well enhance the learning of the so-called basics!

While the literature on environmental education increasingly calls for an holistic approach, the state of the art--that of programs, materials and approaches--is taking the practice in quite the opposite direction. Teachers who once said "give us some materials" are now wondering what they are supposed to do with all that is being advocated as important. Of particular interest are such programs as those dealing with energy education; on the immediate horizon, there may be a similar thrust for programs dealing with hazardous wastes and acid rain. They are coming with well-developed programs, in attractive curriculum packages, and with support monies for implementation training because they are the priority concern of the moment. Likewise, many other organizations, groups, and agencies have over the years refined their offerings into exciting packages and continue to promote under various schemes topic-specific causes--Save The Whale, The Wilderness, Our Wildlife, and others. The simple fact of the

matter is that schools and teachers are now saying "That's a nice program, the materials look good, and we know that each is important, but when are we supposed to do all that? We do have other instructional concerns!" Despite all of our nation's brainpower, we remain sadly unable to recognize a simple truth--"The straw that broke the camel's back." For it is the educational practitioner--the classroom teacher--with whom we burden all these environmental program straws!

There is a simple answer. Given the demands on curriculum and instructional time, that approach to environmental education which provides for integration of environmental lessons, experiences, and activities into ongoing curricula, dealing equally with all environmental concern areas, is the most viable. The materials and instructional strategies already exist to accomplish this. There is but the need to collect the resources and pool the talent to adopt or adapt what already exists into that kind of a viable program.

This current publication, Teaching Basic Skills through Environmental Education Activities, may be an exemplary step in the right direction. The author has gleaned from available resources or otherwise provided learning activities which readily apply to such basics as language arts and mathematics. Thus, while the skill concerns of the disciplines are accounted for, there is at the same time an accommodation for awareness, knowledge, and experience with a wide array of environmental topics. While this volume represents but a sample of the options available for language arts and mathematics, K-12, it does illustrate the potential that exists. These same resources are available for other disciplines--social studies, science, the fine arts, physical education, etc. Any school or district, given the inclination, could readily put together a first-rate education program that is balanced in terms of concern for the total environment, has a logical sequence, and is appropriate to the needs and interests of the community it serves.

Indeed it is time to recognize that environmental education is neither a science domain or responsibility, nor is it outdoor education or nature study, nor does it require extensive specialized training for staff. The competent teacher at any grade level or subject area can teach environmentally; that is what is necessary if the knowledge, the valuing, and the attitudinal change goals are to be achieved.

Robert J. Warpinski
Director
Project I-C-E

Green Bay, Wisconsin
December, 1979

BASIC SKILLS ACTIVITIES

This resource booklet of basic skills activities draws on ideas and materials developed by public school teachers which have become a part of the bank of teaching resources collected by the ERIC Clearinghouse for Science, Mathematics and Environmental Education.

Documents bearing ED numbers have been abstracted in Resources in Education, and generally may be located in ERIC microfiche collections, or may be ordered in microfiche or hard (paper) copy from:

ERIC Document Reproduction Service (EDRS)
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Documents bearing SE numbers are in the local collection of the Information Reference Center for Science, Mathematics, and Environmental Education, and have not been announced through Resources in Education as this volume goes to press. Persons wishing to secure such materials should locate them from other sources; in most cases this will be the listed publisher or organization.

The activities, designed for student use in elementary through high school classes, are "action-oriented" and involve student participation. Each activity has been classified by the author according to the most appropriate level and subject matter involved. In addition to being classified in these categories, each activity contains a statement of purpose on how the activity may be used.

It is hoped that the teachers who use these materials will recognize that the classified categories and statement of purpose serve only as a guide in selecting appropriate activities and should not be considered a fixed structure. In fact, it is recommended that teachers check for activities in the other grade level sections and subject areas that may be appropriate for use or to adapt for use for their own particular set of learners.

The references cited in specific activities found in the resource section of this booklet should be useful to persons interested in obtaining more ideas and activities.

Mary Lynne Bowman

December, 1979

CLASSIFICATION OF BASIC SKILLS ACTIVITIES

Grade Level:	Elementary school	
	Elementary-junior high school	
	Junior high school	
	Junior-senior high school	
	Senior high school	
Subject Area:	Mathematics	including arithmetic, geometry, industrial arts, etc.
	Language Arts	including reading, creative writing, and other communication skills

BREAKDOWN OF ACTIVITIES BY CATEGORY

(Some activities fall into both subject areas)

	Category	Number of Activities
Grade Level:	Elementary school	19
	Elementary-junior high school	13
	Junior high school	11
	Junior-senior high school	17
	Senior high school	5
Subject Area:	Mathematics	38
	Language Arts	32

Elementary School

BASIC SKILLS ACTIVITIES

5/6 10

PURPOSE: To promote the use of all of the senses in the winter environment and to express its beauty through writing.

LEVEL: Elementary School

SUBJECT: Language Arts

REFERENCE: Suggested by Jaclyn V. Hutchings, Elementary School Teacher, Wickcliffe Elementary School, Upper Arlington, Ohio.

MATERIALS NEEDED:

A battery-operated tape recorder with microphone, class chalkboard, white construction paper, scissors, string, tape or glue, ladder and golf tees (one per child).

ACTIVITY:

On a snowy day, explain to class that they are going to take a nature walk on which they will try to use all five of their senses--seeing, hearing, smelling, tasting and touching. Walk through the snow on the playground or neighborhood, and stop occasionally. Recording their reactions with the tape recorder, ask them "How does the snow feel? ...Taste? ...Smell? ...etc." At first the answers will be quite literal, but soon the youngsters will start using more unusual comparisons in the form of similes or metaphors.

Back in the classroom, explain what a "rough draft" is, and that all sorts of ideas will be put on the chalkboard. Write on the board, "Snow:

Smells like...
Tastes like...
Looks like...
Feels like...
Sounds like..."

Allow plenty of room between the categories, and play the tape recorder. Copy the similes already discovered in the out-of-doors and encourage the youngsters to add further ones they can express. An example of a rough draft is found on the following page.

At this stage start letting the youngsters pick the most creative similes out, and let each one copy his/her version of the poem, using two or three similes for each sense. They may use the ones on the board, or any others they may like.

Assign another "Sense Poem," encouraging the use of a rough draft, on any winter subject, such as Slush, Cold, Winter, Ice, Bare Trees, Skiing, etc.

The following day, have students read their best poems aloud if they wish. Using white construction paper, have them cut out snowflakes with diameters of about 8 inches. (Directions for folding and cutting six-sided snowflakes are found in any art or winter activities book, or you can make a pattern for the students.) Children may then copy their best poem on both sides of the snowflake making sure one point of it is perpendicular to their writing. Attach four-foot string to each snowflake with glue and let dry. Attach other end of string to golf tee. Climbing ladder, stick golf tees into hole in acoustic tile which covers ceilings of most classrooms. Snowflakes and poetry will hang all over the room, bringing winter right inside and giving pride to each child.

SNOW (Rough draft)

FEELS LIKE: bits of sky falling on you/ a cold catching on/ frozen toes and hands/ wet sand under your feet/ soft fur/ super-cold talcum powder/ cold plush carpeting/ feathers all over your body/ tiny electric shocks/

LOOKS LIKE: cotton drifting/ elegant lace/ white polka-dots against a velvet sky/ a cloud soaring through the air/ a polka-dot tornado/ feathers from a big pillow-cloud/ an air raid of tiny white bombs/

a white cloud that has exploded/ a polar bear with no features/

TASTES LIKE: cold milk/ hot chocolate burning your tongue/ chapstick/ a piece of vanilla ice cream/ sugar flakes/ cold nothing/

SMELLS LIKE: a breath of fresh air/ the smell after a rainstorm/ clean sheets/ clean water/ a fire in the fireplace/ wetness/ smoke from chimneys/ cold wind/ all the smells have gone to Florida for the winter/

SOUNDS LIKE: a weak blizzard/ a crunchy candy bar/ silence/ snow shovels scraping the pavement/ a quiet mouse or a roaring lion/ everybody is asleep/

*The rough draft was written by Mrs. Hutchings' sixth grade class.

PURPOSE: To illustrate, through vocabulary, the use of energy-related words in the English language; to enrich vocabulary and identify active verbs related to energy.

LEVEL: Elementary School

SUBJECT: Language Arts

REFERENCE: Suggested by Jaclyn V. Hutchings, Elementary Teacher, Upper Arlington City Schools, Upper Arlington, Ohio.

ACTIVITY:

Discuss energy-related activities. Make list on board. Assign students job of finding as many energy-related words as they can. It can be a synonym for sun, energy, or a word that requires energy. Words such as "solar, moving, dancing, working, etc."

Make discs out of yellow construction paper. One should have a diameter of 12 inches; the rest should have a diameter of 6 inches. On 12-inch disc, write "sun equals energy." On smaller discs write words collected. Have students do this in different-colored markers.

In one end of hall, tape sun disc to wall. Scatter other discs down hall wall. Add to, daily. Makes excellent hall display for whole school.

PURPOSE: To help students express themselves by using the senses both in the written as well as the spoken word.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: Suggested by Joan Lake. Murray State University Workshop in Environmental Education. Youth Station, Land Between the Lakes, 1971. ED 077 696.

ACTIVITY:

Discuss with your students good listening habits.

Ask the class to list or name sounds they commonly hear. Discuss the sounds the students listed:

1. Identify the sound.
2. What did the sound make you think of (past experiences)?
3. Were the past experiences pleasant or painful?
4. Make a list of words or phrases that describe your feelings at the time you heard the sound.
5. List as many descriptive words as you can think of to describe the sound. (Example: Buzz, insistent, low-pitched.)

By adding other words or phrase modifiers to the base sound, write one sentence about each sound describing the sound or your feelings when you heard the sounds.

Take your class to a natural area and ask them to find an object (mushroom, wildflower, tree, etc.) that they think is beautiful. Feel and examine the object.

List as many words as you can think of to describe that object--dainty flower, moist, rubbery, golden mushroom, etc. Write one sentence using as many of the descriptive words as you can--you may also add other word or phrase modifiers to describe your feelings about the object.

Have students read their sentences.

Discuss those descriptive words used that might be new to some students and help them add the words to their vocabulary.

PURPOSE: To practice communicating feelings, moods and ideas about nature.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: Suggested by Joan Lake. Murray State University Teachers' Workshop in Environmental Education. Youth Station, Land Between the Lakes, 1971. ED 077 696.

ACTIVITY:

Discuss with your students how you recognize the different senses. Ask:

1. How do you know your mother is cooking bacon in the morning if you do not see it? (Smell)

2. How do you know the color of my dress is blue? (See)

3. How do you know chocolate candy is sweet? (Taste)

4. How do you know tissue is soft? (Feel)

5. How do you know a dog is barking? (Hear)

These five things--smell, sight, taste, feel, and hearing--make up your five senses.

Make a "feel" chart on the chalkboard containing the following words: fuzzy, soft, hard, sticky, rough, smooth, long and short. Ask each child to observe and select an object that fits the words from the feel chart. They will decide who has the best object and place it on the chart. As each student shares his object, ask them to further describe it; i.e., fuzzy as what, etc.? This will help to build vocabulary.

Take your class out-of-doors to utilize their senses for environmental observation. Ask each child to identify three objects and tell what sense(s) he/she might use. For example, bark on a tree. Can we hear the bark? Can we see bark? Can we smell bark? Can we taste bark?

PURPOSE: To experience objects by feeling, tasting, smelling, hearing and seeing them (nouns) as they are and how the student imagines them to be, and to introduce poetry.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: In and Out: 101 Activities To Enrich The Learning Experience. Edwin Gould Outdoor Education Centers, Green Chimneys School and Lakeside School, Brewster, New York 10509. ED 184 735.

ACTIVITY:

1. The teacher will lead the group on a short hike and have the students pick an object, and will then ask them to describe the object.

2. Record their observations.

3. Question the student on his/her own selection of words and possibly help to refine the perceptions.

4. Pick a second object and describe it in the process of doing something. The student simply records his feelings on the objects and movement in relationship to himself.

EXAMPLE:

The following four poems were written by Derek Kratlian and Richard Cruz following the previously described method:

The tree is bending over
cause maybe he wants to pick something up
or maybe he wants some soda

The building is making a shadow
on the middle roof, right from both sides
we eat in there
and I think it's a good tree

D. Kratlian

The rock it looks nice
in the middle of the field
that's what's nice about it
with the clock on it
working a sun dial
the sun turns and you don't need a clock
it's good you don't have to plug it in

R. Cruz

The horses near the trees
their long tails are swatting at the flies
grazing in the field
all happy
they think about their fillies
they're in the shadow
I'm in the sun

D. Kratlian

The Soccer Field

When it was muddy and rainy
we had cleat marks all
the field
last year
I felt proud of the team
that was the last game
we ever had
sitting on the bench
the sun hitting me
the butterfly flying across
the field
I feel funny

R. Cruz

The only help given to these children was to question their observations and to arrange the words into line structure and sense.

SOME DISCUSSION QUESTIONS COULD BE:

Why are these called poems?
Are there other types of poetry?

RELATED ACTIVITIES:

Start a personal poem diary or class literary magazine.
Read poems in class.
Use some of the words as a spelling list.
Include poems in the school bulletin or newspaper.

PURPOSE: To help pupils become more aware of words and language intonations which are related to natural objects in the environment. To help pupils improve their powers of observation while on field trips.

LEVEL: Elementary School

SUBJECT: Language Arts

REFERENCE: Suggested by Herbert L. Coon, Research Associate, ERIC Clearinghouse for Science, Mathematics and Environmental Education, Columbus, Ohio 43212.

ACTIVITY:

Prior to taking a field trip for this specific or some other purpose, tell the class that when they return to their room they will develop an experience chart on which they will categorize under the five senses the things they experienced on the trip.

They will also be asked to identify words which will describe their observations or other sense experience:

What words can be used to describe a forest or tree?

The actions of a bird?

The odor of a flower?

The feel of wet moss?

The smell of pine needles?

The activity might be culminated with a group or individual writing effort to describe as vividly as possible some of the highlights of the field trip.

PURPOSE: To practice using nouns and verbs by identifying objects on the school ground involved in specific action.

LEVEL: Elementary School

SUBJECT: Language Arts

ACTIVITY:

Give your students a list of five verbs such as: running, blowing, falling, growing, lying and rising. Next ask them to go outside on the school yard and observe or collect five things (nouns) in the environment that can be placed with each verb on their list. For example: spider running, grass blowing, acorn falling, flower growing, dog lying, and smoke rising.

After they have collected or observed their "nouns" in action, ask them to write a short story using all of the nouns and verbs. As each student shares his/her story, the remainder of the class should determine whether or not the nouns and verbs were used correctly.

PURPOSE: To practice basic reading skills by focusing on environmental abuse.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: H. B. Lantz, Jr. Environmental Education and Reading. ESEA Title III Project, Orange County High School, Orange, Virginia 22960. SE 021 510.

ACTIVITY:

Ask your students to read the following paragraph and to answer the reading skill problems listed.

HOW DO PEOPLE ABUSE THE ENVIRONMENT?

Have you seen people suffering when the city is covered with smog? Have you seen brushland or forest land destroyed by war? Have you seen a landscape spoiled by junkyards, billboards, and wrecked cars? Have you seen a waterway polluted with sewage or industrial waste? Conditions that make life uncomfortable, dangerous or unhealthy are ABUSES. What are some abuses of our environment?

*READING SKILLS:

1. Word Attack Skills

   Context Clues--After reading this paragraph, write a definition for the word, abuses.

2. Comprehension Skills

   Noting Details--Make a list of all of the abuses mentioned in the paragraph. Try to add three more abuses of your environments.

3. Comprehension Skills

   Drawing Conclusions--How does smog make life unhealthy or uncomfortable? Do junkyards, billboards and wrecked cars make life uncomfortable, dangerous or unhealthy? Why? Can you add another category to the abuses that could fit junkyards better?

4. Word Attack Skills

Blends--Make a list of all of the words in the paragraph that contain blends. The word may begin or end with a blend or have a blend in the middle--underline the blend.

(smog forest destroyed waste brush)
(spoiled billboards environment)

5. Word Attack Skills

Compound Words--There are four compound words in the paragraph. List them. Draw a line under each part that is a word.

(landscape, junkyards, billboard, waterway)

PURPOSE: To practice word attack skills and comprehension skills as a result of investigating various ways the environment is abused.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: H. B. Lantz, Jr. Environmental Education and Reading. ESEA Title III Project, Orange County High School, Orange, Virginia 22960. SE 021 510.

ACTIVITY.

Conditions that make life uncomfortable, dangerous, or unhealthy are called abuses.

Ask students to look around their homes or apartment building. Describe the different abuses found there--for instance, papers, food scraps, empty cans and bottles, bad smells, destruction of trees and other plants. Explain that this kind of looking and reporting is called making a survey.

Photograph some of these abuses and make a display of the photographs. In the same way, make a survey of your school building, your school grounds, your neighborhood, and if possible, your city. Look for cars and buildings that give off a lot of smoke and piles of garbage that attract rats. Also look for polluted waterways.

Give each student the above instructions and ask them to complete the following problems:

1. Word Attack Skills

   Context Clues--Write a definition for the word survey after you have read the second paragraph.

2. Word Attack Skills

Syllabication--There are some multi-syllable words in this reading. List them, then draw one line under the prefixes and two lines under the suffixes when present. Write the root word behind the underlined words.

conditions

uncomfortable	comfort
dangerous	danger
unhealthy	health
destruction	destruct
photograph	

3. Word Attack Skills

Accent

Skim the reading. Write ten words that have more than one syllable. Place the primary accent in these words. Divide into syllables.

con di' tion

un com' fort a ble

dif' fer ent

4. Word Attack Skills

Vowels

Find all words that have the same vowel sound as the word listed. Circle the vowel in the words you choose.

white l(i)fe, describe, find, kind, piles

boat h(o)me, photograph, smoke, also(o)

cat scr(a)ps, c(a)n, b(a)d

5. Comprehension Skills

Classification--Survey the abuses in your neighborhood. Classify them as to whether they are dangerous, unhealthy or uncomfortable for life.

Abuses to Life

Dangerous	Unhealthy	Uncomfortable

6. Comprehension Skills

Sensory Image--We have 5 senses. Which senses are used to observe and evaluate these abuses?

1. bad odors _____
2. heavy smoke _____
3. piles of garbage _____
4. loud radios/TV _____
5. airplane landing _____

7. Comprehension Skills

Predicting Outcomes--Before you make your survey, write the kinds of abuses that you think you will find. After your survey, check to see how many abuses that you predicted were correct.

PURPOSE: To practice comprehension and word attack skills after conducting an experiment involving the effect of smog and smoke on plant growth.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: H. B. Lantz, Jr. Environmental Education and Reading. ESEA Title III Project, Orange County High School, Orange, Virginia 22960. SE 021 510.

ACTIVITY:

With your students conduct the following experiment to determine the effect of smog and smoke on plant growth.

Plant five radish seeds in each of three small clay pots filled with earth to a depth of about 5 cm. Water the seeds regularly and wait until leaves appear. Label the pots A, B, and C. Place each pot in a small dish. Get two clear plastic bags (sandwich size) and two rubber bands. Cover pot B with a bag and fasten the bag in place with a rubber band.

Burning matches give off an unpleasant smoke. Take two wooden kitchen matches and stick them into the soil in pot C. Light a third match and use it to light the other two matches. While the matches are burning, carefully slip the second bag over the pot and fasten it in place with a rubber band. The matches will burn out quickly, leaving smoke in the air over the seedling.

Keep the pots on a window sill and water them regularly by pouring a small amount of water into the dishes in which they were placed.

Observe the plants each day for at least three weeks, and keep a log of your observations. What conditions are different for the seedlings in pots A, B, and C? What conditions are the same? How do each of their growth rates differ? Watch how the leaves grow and change. What conclusions can you draw?

Give students the following comprehension and word attack problems:

Sequence of Events

Read these steps: Compare them to the steps of the experiment. Put numbers in front of each statement that shows the sequence that the directions must follow.

_____ Plant 5 radish seeds in 3 small clay pots to a depth of 5 cm.

_____ Keep a log of your observations.

_____ Water the seeds regularly.

_____ Put two wooden matches in one pot.

_____ Place each pot in a small dish.

_____ Keep the pots on a window sill.

_____ Wait until the leaves appear.

_____ Label the pots A, B, and C.

_____ Get two clear plastic bags and two rubber bands.

_____ Light the third match and use it to light the other two matches.

_____ Cover pot B with a bag and fasten bag in place with rubber band.

_____ Slip the second bag over the top of pot C while the matches are still burning.

_____ Water the plants regularly by pouring water in the dishes.

_____ Observe the plants for 3 weeks.

Suffixes

Copy each two-syllable word in the directions. Draw a line around all words that have suffixes or endings. Write the root words and base words of those words in circles.

rubber	quickly
fasten	leaving
burning	seedling
matches	window
wooden	pouring
kitchen	amount

PURPOSE: To write a story comparing and contrasting the different environments of a city tree and a country tree.

LEVEL: Elementary School

SUBJECT(S): Language Arts

REFERENCE: Project I-C-E. Environmental Education Guide: Grade Two. 1927 Main Street, Green Bay, Wisconsin ED 100 654.

ACTIVITY:

Inform your students that they will be writing stories around the theme "City Tree, Country Tree." Their stories should be from the tree's point of view of life in the city and life in the country. The following points should be covered in each story:

a. Where you live
b. Why you live here
c. Who your neighbors are
d. How you help other plants and animals
e. What you feel towards people

Now, divide the class into two groups. Members of one group will write their story on the city tree, the others on the country tree. When they have completed their stories, and have shared them with the class, list the common points of each group on the chalkboard and compare and contrast the two environments. You may wish to ask each student to draw a picture of his/her tree and its surrounding environment.

PURPOSE: To practice learning how to count, to distinguish colors and shapes of different leaves, and to increase awareness of the variety of shapes in the natural world.

LEVEL: Elementary School

SUBJECT(S): Mathematics

REFERENCE: In and Out: 101 Activities To Enrich The Learning Experience. Edwin Gould Outdoor Education Centers, Green Chimneys School and Lakeside School, Brewster, New York 10509. ED 184 735.

ACTIVITY:

1. Walk out-of-doors looking for freshly fallen leaves. (Do not pick the leaves off the trees.)
2. Have the children gather leaves selectively and put them into individual bags.
3. Return to the classroom.
4. Count all the leaves for a total.
5. Classify them by shapes and then by color.

RELATED ACTIVITIES:

Count the number of petals on flowers.

Make leaf prints when you are through counting.

PURPOSE: To reinforce counting, addition and subtraction skills and to increase awareness of sounds in the environment.

LEVEL: Elementary School

SUBJECT: Mathematics

ACTIVITY:

Ask your students how many sounds they think they might hear on a 5- to 10-minute walk around the outside of your school building. Record this figure. Take a portable tape recorder and, with the class, walk around the building taping sounds. (You should remind children before departing that you want to tape sounds that are already outside and not sounds made by the class during the walk.)

Upon returning to the classroom, ask children how many sounds they thought they heard. Record this figure. Play the tape and count the sounds. Compare results. How many are man-made sounds? How many are "nature" sounds? Which sounds did they like best? Least? Why?

PURPOSE: To investigate the average gasoline prices of the past 10 years and to survey gas station operators in the community.

LEVEL: Elementary School

SUBJECT(S): Mathematics

REFERENCE: Barry W. Jamason. Living Within Our Means: Energy and Scarcity. The University of the State of New York and The New York State Education Department, Albany, New York 12234. ED 093 673.

ACTIVITY

Have several members of the class do research to find what the average price of gasoline was during each of the last 10 years in the United States. They should include information about the total number of gallons sold each year as well, and present all their findings to the class using some form of pictorial representation.

- o In what year was the most gasoline sold? Why?
- o In what year was the least amount sold? Why?
- o What was the lowest average annual price per gallon and in what year did it occur?
- o What was the highest average price per gallon and for what year did this happen?
- o What are some of the factors that cause changes in the price of gasoline?
- o What is the difference between the highest and lowest average price per gallon?

To continue the activity, help the class conduct a survey of gas station operations in your community. Divide the class into three groups, each of which will cover one of three stations selected for observation. The groups should record the grades of gasoline sold and the price per gallon of each at their respective locations. (Have them graph the results back in the classroom.) Next, the teams should record for one hour the number of customers,

the amount of gas purchased, and each total sale. At the end of the hour, the teams should produce figures for total gallons sold and the total cash receipts for the gas station.

- o What will 10 gallons of each of the grades available cost at the three stations?
- o How many cars purchased gasoline in one hour at each station?
- o How many gallons of gasoline were sold at each station?
- o What was the highest individual sale, and what was the lowest?
- o What was the total amount of money taken in at each station in one hour?
- o Which station took in the most?
- o How much more was taken in at this station than at each of the other two?
- o Can you find out how much of the gross receipts (the total amount taken in) is profit? Is the profit high or low in your opinion? Why?
- o How many customers kept their engines running for more than 1 or 2 minutes as they waited in line? What do you have to say about that?
- o Do we waste gasoline in this country? Explain.
- o Would the price of gasoline be any lower if we were more careful about conserving gasoline? Why or why not?

PURPOSE: To calculate the amount of sound absorbed by trees along a highway.

LEVEL: Elementary School

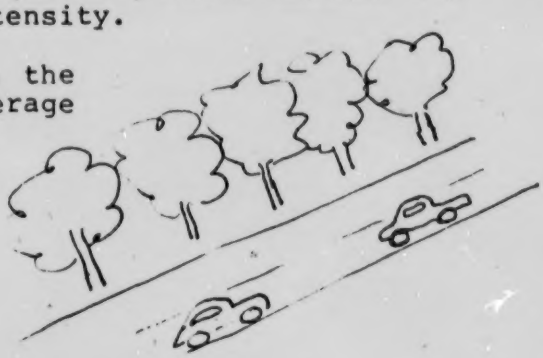
SUBJECT(S): Mathematics

REFERENCE: Oregon Mathematics Resource Project, November, 1975.

ACTIVITY:

Trees cut noise pollution by acting as barriers to sound. Each 3 metre (or 10') width absorbs 6-8 decibels of sound intensity.

Along a busy highway, the traffic noise can average 70 decibels--3 trees (each 1 metre wide) would reduce the decibel range to what levels nearby?



6 trees (each 1 metre wide) would bring the noise down to a range of _____ to _____ decibels.

Investigate the busy streets or highways around your city. Have trees been planted nearby? Could they be planted? Discuss this plan with the traffic engineer or highway departments.

In what other ways do trees help if planted near highways or traffic?

PURPOSE: To estimate the fractional equivalent of the percent of various kinds of litter found along the highway.

LEVEL: Elementary School

SUBJECT(S): Mathematics

REFERENCE: Oregon Mathematics Research Project, November, 1975.

ACTIVITY:

Recent surveys continue to show that highway litter is composed of

59%	16%	6%	6%	13%
paper	cans	bottles	plastic	miscellaneous

True or False?

1. About 1/2 of the litter is cans.
2. Paper accounts for about 10 times as much litter as bottles.
3. Paper is about 4/5 of the total amount of litter.
4. 3/4 of the litter comes from paper and cans.

Take a litter count along the streets beside your school. Tally each piece into one of the above types and change to percentages. How do they compare?

If possible, find out information about litter along your state's highways. Has it been increasing or decreasing in recent years? How does it compare to this national survey?

PURPOSE: To solve problems dealing with the amount of water wasted by a dripping faucet in a given period of time and compare amounts of water wasted by different faucets.

LEVEL: Elementary School

SUBJECT(S): Mathematics

REFERENCE: Project I-C-E. Environmental Education Guide: Grade Two. 1927 Main Street, Green Bay, Wisconsin. ED 100 654.

ACTIVITY:

Dripping faucets send clean, usable water into the sewers.

Demonstrate a procedure used to determine the amount of water wasted by a dripping faucet by collecting the water in a cup container for 1 hour and multiplying this by 24 hours.

Next ask students to find the total number of leaky faucets in school and in all homes of the students and the teacher. Together find the total waste of water if each wasted the same volume.

Ask students to solve the following problems.

1. Mary's leaky faucets wasted 15 cups of water a day. John's leaky faucets wasted only 6 cups a day. How much less water was wasted in John's home?

2. After Tom repaired the leaky faucet, it only dripped 1 cup a day. Before it was repaired, it dripped 11 cups a day. How much did he save?

3. During one day, Bob used water five times. The first time he wasted four cups, the next two times he wasted five cups, the fourth time he wasted six cups, the last time he wasted eight cups. How many cups of water did he waste?

4. If Mary uses 30 gallons of water in one day and Barb uses 42 gallons in one day, who uses more water? How much more?

5. If John forgot to shut off the water tap after getting a drink, how much water would he waste in three hours if eight gallons of water came out of the tap every hour?

PURPOSE: To chart and calculate costs associated with daily living expenses.

LEVEL: Elementary School

SUBJECT(S): Mathematics

REFERENCE: Project I-C-E, Model Activities Series, 1927 Main Street, Green Bay, Wisconsin.

ACTIVITY:

Many times children are not really aware of the economics of the world. This exercise is designed to allow a student insight into the cost of products that are served up to him in his daily life. Sometimes knowing what a product's dollar amount is adds impetus to a person's respecting and taking care not to abuse the item or overuse it.

Give each student a copy of the form on the following page and ask them to make a list of all the items used, eaten or worn for one 24-hour period.

After you have filled in the form, take it to a local store and price the food items listed. Suggestion: Your local newspaper can aid you in pricing some of the items. Do the same with clothing and furniture. Suggestion: Using a catalog from Sears-Roebuck or another store will aid you to get accurate prices.

Ask your parents to aid you in obtaining an approximate cost of water and power bills for one month. Divide this figure by 30 to get the cost for one day, then divide the figure by the number of people in your family to find out the cost of the items you use.

Total all columns after they are completed. Take all columns and add them together for a grand total.

- -

Suggestions:

1. Explore what you might do to lower costs in each of the columns.

2. Compare your costs with other students and exchange ideas for conserving.

Fill in the amounts you used for one day's time; use fractions of amounts when appropriate. Be as accurate as you can when approximating your costs.

Food	Clothing	Furniture	Water	Power (Gas/Electric)
1. _____cost	_____cost	_____cost	_____cost	____ time used for ____
2. _____cost	_____cost	_____cost	_____cost	____ time used for ____
3. _____cost	_____cost	_____cost	_____cost	____ time used for ____
4. _____cost	_____cost	_____cost	_____cost	____ time used for ____
5. _____cost	_____cost	_____cost	_____cost	____ time used for ____
6. _____cost	_____cost	_____cost	_____cost	____ time used for ____
7. _____cost	_____cost	_____cost	_____cost	____ time used for ____
8. _____cost	_____cost	_____cost	_____cost	____ time used for ____
9. _____cost	_____cost	_____cost	_____cost	____ time used for ____
10. _____cost	_____cost	_____cost	_____cost	____ time used for ____
_____ Total	_____	_____	_____	_____

Grand Total _____

Examples:

Food- Cost of 1 egg equals the current cost of one dozen eggs, divided by 12.
Clothing- Current prices in catalog or store.
Furniture- Use prices of new furniture.
Water- Approximate amount used; divide into total cost as appropriate.
Power- Use monthly bills to figure individual cost per day.

3. Discuss what resources were provided to you by a service agency.

4. Mathematically explore percentages such as: Your cost over a day, month, year and/or other similar percentages.

5. Discuss the multiplier effect if costs were multiplied times the number in a family, city, state, nation.

6. Compare your situation with a student in another country.

PURPOSE: To calculate problems dealing with home energy consumption and as a class to develop a newspaper listing conserving practices and encouraging school families to practice energy conservation.

LEVEL: Elementary School

SUBJECT(S): Mathematics
Language Arts

REFERENCE: Suggested by Linda Campbell, Elementary Teacher, Arlington Park Elementary School, Columbus, Ohio.

ACTIVITY:

A. Discuss with students the information that over 90 percent of our energy used today is fossil fuels and nonrenewable. Find information telling how long these fuels are expected to last. Pose question to students, "What can we do about it?"

B. Have students read meters at their homes and find out how much electricity they use in a 24-hour period. Bring results to class and record on chart.

C. Discuss how to conserve energy with class, and list their suggestions on a chart. Have children go home to discuss it with family and try conserving for 24 hours. Student records results from meter for the 24 hours of conserving and brings results back to class and records on chart. (Students can have codes instead of names to prevent embarrassment.)

D. Class then figures how much total used in unconserving period (for class and for self) and how much used in conserving period (for class and self). Then students can subtract and find out how much energy was saved by the class by conserving.

E. Have student call Electric Company to find out cost per kilowatt hour and how much fuel (coal, oil, etc.) would be used for so many kilowatt hours. Ask if consultant would come out to talk to students.

F. Find out how much money was saved for that 24-hour period. Use averaging to find out savings of energy and money, on the average, for each family. Also have students figure out their own personal savings.

G. Have students develop a newspaper to send home with students in school. The newspaper could include an explanation of their project, findings of the project, conservation practices students suggest, energy cartoons and poetry, and an article on the concern that 90 percent of fuel used today is nonrenewable fossil fuels, and the projected end of them. Students could also explain what fossil fuels are, why they are so much in use, and how they affect the environment.

   Students could include an offer to other families who would like their energy use and cost per day or year figured. In the newspaper students could suggest trying conservation measures suggested for one day and offer to figure savings for families interested. Students can respond by letter to people who show interest (use proper letter form).

H. Students then could compile statistics to figure out how many total families involved, average savings (energy and money) per day and year, total savings per day and year.

I. Find out population (homes in city by census?) of city (state and country?), and figure out savings (money and energy) for each if all people practiced conserving energy and averaged the savings of the class's population sample.

J. Publish the results in a new issue of their newspaper.

K. Discuss the impact they, as elementary students, had on their community.

Elementary-Junior High School

BASIC SKILLS ACTIVITIES

PURPOSE: To learn to use two figures of speech (simile and metaphor) and express your feelings about a given natural setting by using comparison.

LEVEL: Elementary-Junior High School

SUBJECT(S): Language Arts

REFERENCE: Suggested by Josephine Malone. Murray State University Teachers Workshop in Environmental Education. Youth Station, Land Between the Lakes, 1972. ED 077 698.

INTRODUCTION:

All of us like to be able to influence people for various reasons. Perhaps you would like to influence your mother to serve fried chicken for dinner tonight, or you would like to influence your teacher to give you an A in history. When you become an adult, you may want to influence people to vote for you for some public office. To enable ourselves to realize such desires, we need to express ourselves accurately and well. One easy way to help people form an accurate mental picture of a situation is to use comparison. You often say, "I feel like --------," "You look like --------," or "He acts like --------."

ACTIVITY:

Give the class a good example of the simile, such as, "He crept across the floor like a thief in the dark." Note the use of the word like. We might use as the same way. Now, ask the pupils to compare by using the simile. You must use like or as in the sentence. Sometimes when comparing, instead of saying something is like something else, we that it is or was something else because it reminds us of another object. (Hold up a mushroom.) I can say, "My plant is an umbrella." Notice that I didn't say it looks like an umbrella. This kind of comparison is called a metaphor. Now, ask the pupils to use a metaphor in a sentence.

Now, ask the pupils to go to some particular site alone this evening at 7:00 o'clock and to quietly sit and observe. Then at 7:00 o'clock tomorrow morning, return to that same site; sit quietly and observe. Write a paragraph comparing the situation at those different hours. Check to see that you use similes and metaphors as you write.

PURPOSE: To sharpen writing skills by focusing on the topic sentences of an article discussing the current energy shortage.

LEVEL: Elementary-Junior High School

SUBJECT(S): Language Arts

REFERENCE: Barry W. Jamason. Living Within Our Means: Energy and Scarcity. The University of the State of New York and The New York State Education Department, Albany, New York 12234. ED 093 673.

ACTIVITY:

The following three paragraphs constitute a summary of the information presented in a recent magazine article. Note that details given in the paragraphs develop the topic sentence or main idea which begins each paragraph.

The present energy shortage is basically a problem of meeting an increasing demand for energy at a time when the supply of energy resources is decreasing. By 1990 the United States will probably have about doubled its present energy consumption. Domestic oil and natural gas, which account for two-thirds of the nation's energy, will be able to meet only 40 percent of demand. Nuclear, hydro, solar, and geothermal, and other nonfossil sources will take care of another 20 percent.

To fill the remaining 40 percent gap the nation faces two possible choices. It can import much more oil and gas, and incur more political dependence on foreign countries. Or it can turn to coal, which now provides 20 percent of U.S. energy.

Coal is a rich resource, but it presents many problems. It is dirty to burn and thus a great source of pollution. It is also difficult and dangerous to mine. For this reason, Congress passed the National Coal Health and Safety Act which has sharply increased operating costs. Strip mining, a process of peeling back the earth and gouging out the underlying coal, is less costly than working underground in deep shafts. But stripping has left scarred and torn land in vast areas. If Congress

passes a law, as it should, compelling strip miners to repair the ravaged earth after mining, additional expense and difficulties of reclaiming some of the land will arise.

Have the children copy the topic sentence in each of the paragraphs. Point out that it is a good idea to vary the beginning words when writing paragraphs. Call attention to the fact that in this article the writer begins each paragraph in various ways. The youngsters should circle the first word or two in each paragraph and then answer the questions below as they pertain to each paragraph.

- How does the writer suggest that our requirements for energy will increase in the future?
- Does the writer imply that oil and gas production will become greater or less in 1990?
- In line 6, the word "domestic" means:

  (not wild) (of the family or household) (found in the United States)

- In lines 12-14, what word means "to bring down upon oneself"?
- Why would importing more oil and gas make us increasingly dependent upon foreign countries?
- What are the problems of coal as a resource?
- What are some drawbacks to strip mining?
- In lines 26-28, what word means "damaged or destroyed by violent action?"
- What is meant by "reclaiming land?"

PURPOSE: To recognize and utilize patterns of organization by time-ordering environmental events.

LEVEL: Elementary-Junior High School

SUBJECT(S): Language Arts

REFERENCE: Barry W. Jamason. Living Within Our Means: Energy and Scarcity. The University of the State of New York and The New York State Education Department, Albany, New York 12234. ED 093 673.

ACTIVITY:

Present the following list of developments, or a similar list of your own making, to the children. Have each child assign numbers to the events by way of placing them in chronological order (Recognize and Utilize Patterns of Organization--Time Order)*.

- (1) Henry Ford applied the assembly line technique to the manufacture of automobiles.
- (2) Oil-producing countries refused to sell oil to the United States (and others) for political reasons.
- (3) The Wright Brothers successfully flew a machine-propelled glider at Kitty Hawk.
- (4) Machine-produced goods began to replace handmade articles.
- (5) Colonel Drake developed a practical way of pumping oil from the depths of the earth, and this fossil fuel began to replace coal in importance.
- (6) The use of home heating oil and gasoline was curtailed in order to conserve energy.
- (7) Earth Day was inaugurated to awaken us to the alarming facts of what we have been doing to our environment.

- (8) By government edict, only automobiles which travel at least 16 miles on a gallon of gasoline may be sold in the United States.

- (9) The earth's population jumped from 1 billion (1830) to 3 billion (1960).

- (10) Gasoline was rationed in order to divert this vital fuel to our war effort.

*(KEY--The correct sequence is: 4, 5, 3, 1, 10, 9, 7, 2, 6, 8 [not yet].)

When the class has finished the exercise, discuss with them the ways in which each event is related to the present energy problem.

PURPOSE: To develop skill in accurate reporting by investigating factors related to the energy shortage.

LEVEL: Elementary-Junior High School

SUBJECT(S): Language Arts

REFERENCE: Barry W. Jamason. Living Within Our Means: Energy and Scarcity. The University of the State of New York and The New York State Education Department, Albany, New York 12234. ED 093 073.

ACTIVITY:

Environmental problems are timely, vital subjects which can be capitalized upon in developing the reportorial skills of children. First, reproduce the list below for the class. Then ask them, preparatory to making a report on the energy shortage, to select the items most relevant to the report and to discard the unrelated items.

- o The world's population is doubling every 35 years.
- o The United States has increased its energy consumption by 4 or 5 percent for each of the past several years.
- o Advertising encourages the sale of products which are not necessary or even desirable, but which will make money for the company.
- o Oil painting on canvas is an art that is gaining in popularity as a hobby.
- o The United States throws away 74 billion cans and bottles each year.
- o Harnessing the tides and winds is being considered as an additional source of energy.
- o The state of Connecticut is building a plant which will reclaim metals and other usable materials from garbage and trash, and turn most of the remaining trash into fuel.

- Unemployment has been on the rise in the United States, and is increasing again this year.
- Most of our beverages are packaged in nonreturnable bottles.
- Whales are on the endangered species list.
- Home air conditioners use approximately 2,000 kilowatt hours per year.
- National parks may find it necessary to require people to make applications for camping dates in order to prevent congestion and overuse.
- The United States has been manufacturing only two-thirds of the energy it uses, and has been importing the rest.
- Cities do not want power plants built near them because of thermal pollution, visual pollution, and the danger of radiation.

PURPOSE: To sharpen descriptive writing skills as students respond to an open-ended question referring to man's dependence on trees.

LEVEL: Elementary-Junior High School

SUBJECT(S): Language Arts

REFERENCE: Environmental Education Instructional Unit: Natural Resources. Department of Public Instruction/North Carolina Department of Public Education, Raleigh, North Carolina, 1972-73. ED 092 379.

ACTIVITY:

Have a discussion of what things would look like with no trees.

a. What items would man miss?

b. What would become of the millions of people who depend on trees for their living?

Ask your students to write a descriptive statement of what the world would be like if there were no more trees. How would our daily lives be affected?

Note: Students should be encouraged to consider the economic and aesthetic results.

PURPOSE: To develop proficiency in using a compass, and to apply previously learned mathematics skills in an outdoor setting.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics

REFERENCE: In and Out: 101 Activities To Enrich The Learning Experience. Edwin Gould Outdoor Education Centers, Green Chimneys School and Lakeside School, Brewster, New York 10509. ED 184 735.

ACTIVITY:

List on several filing cards the bearings needed to complete various geometric shapes.

1. Have your students follow the directions below, using a compass. Identify the shape (rectangle, square, etc.).

   EXAMPLE:

   a. Mark the spot you start from.
   b. Take a bearing of 90 degrees and measure off 10 meters. Mark this spot.
   c. Take a bearing of 180 degrees and measure off 10 meters. Mark this spot.
   d. Take a bearing of 270 degrees and measure off 10 meters. Mark this spot.
   e. Take a bearing of 360 degrees and measure off 10 meters. Mark this spot.
   f. What geometric shape did you form? Hopefully, a square.

2. Some other shapes. . .

   a. 5 degrees for 10 meters
   b. 95 degrees for 20 meters
   c. 185 degrees for 10 meters
   d. 275 degrees for 20 meters

   RECTANGLE

   a. 30 degrees for 5 meters
   b. 150 degrees for 5 meters
   c. 270 degrees for 5 meters

   EQUILATERAL TRIANGLE

More complex shapes can be laid out by simply making a large drawing of the shape on an 8-1/2 X 11 sheet of graph paper.

Orient the paper so that the top is toward north. Without turning the paper, use a compass to determine the bearings needed to form each angle of the shape. Any scale can be used for determining the size of the object to be constructed (perhaps 1":12' would be suitable).

This activity will reinforce the use of the compass, recognition of geometric shapes and measurement using English and metric units.

RELATED ACTIVITIES:

Use string and tent pegs to mark out shape being made.
Have capable students make up cards for others to follow.
Have a scavenger hunt based on compass reading and measuring.
Using the same approach as above, spell out words rather than making shapes.

PURPOSE: To sense nature's enormous reproductive power.

LEVEL: Elementary-Junior High School

SUBJECT: Mathematics

REFERENCE: Judith M. Schultz and Herbert L. Coon. Population Education Activities for the Classroom. ERIC Clearinghouse for Science, Mathematics and Environmental Education, The Ohio State University, Columbus, Ohio. ED 141 178.

ACTIVITY:

Working in pairs have each group find and bring into class a mature dandelion head. Count and record the number of seeds it contains. Record the data from each group on the chalkboard and calculate the average number of seeds found in one head.

Assuming that all seeds can grow and produce dandelion plants, how many descendants are possible in four generations from this one head of seeds?

Why isn't the entire world covered with dandelions? What factors limit the number of animals, such as rabbits, that can survive? What factors might or do limit the number of human beings that can live on earth?

PURPOSE: To assist students in assimilating the large numbers associated with population size.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics

REFERENCE: Teaching Population Concepts, by Pat King and John Landahl for the Office of the Superintendent for Public Instruction, Olympia, Washington, 1973, p. 39. (Activity suggested by Jeanette Furness.) ED 108 857.

ACTIVITY:

To help students understand the large numbers often used in talking about population, have them figure out how big a lawn containing one million blades of grass is. They can do this by each counting the number of blades of grass in a square inch of lawn and working out an average. Multiply this number by 144 to calculate the number of blades in a square foot. Divide the number of blades in a square foot into one million to calculate the number of square feet needed. About how long and how wide would a patch of lawn containing this number of square feet be? Stake it off on the lawn. If this is the size of a lawn containing one million blades of grass, how big would a lawn containing one billion blades be, if a billion is one thousand times one million?

PURPOSE: To calculate the gas and money that could be saved by carpooling.

LEVEL: Elementary-Junior High School

SUBJECT: Mathematics

REFERENCE: Environmental Education: Energy-Transportation: Grades K-8. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 821.

ACTIVITY:

Ask each student to interview someone who commutes to work by car. Determine the average daily and weekly amount of fuel consumed and the cost. Imagine that each person started a car pool in which four people rode in each car. Compute the amount of gas and money saved by using one car instead of four.

PURPOSE: To solve mathematical problems referring to the forest lands in the United States.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics

REFERENCE: Environmental Education Instructional Unit: Natural Resources. Department of Public Instruction/North Carolina Department of Public Education, Raleigh, North Carolina, 1972-73. ED 092 379.

ACTIVITY:

Ask your students to solve the following problems:

1. National forests contain about 1/6 of the U.S. commercial woodland. The national forests contain 180,000,000 acres of commercial woodlands.

   How many acres of commercial woodland are there in the United States?

2. 60 percent of the nation's commercial woodland acreage is in small private holdings.

   Small holdings contain how many acres?

3. One-half of the small-holding acreage is in holdings of about 40 acres each.

   About how many such small holdings are there?

4. In a single year, about 1/20 of the commercial forests burn.

   About how many acres burn in a single year?

Answers to the above are as follows:

1. 1/6 of commercial woodland is 180,000,000 acres. (Let W = woodland)

$$\frac{1}{6} \times W = 180{,}000{,}000$$
$$W = 180{,}000{,}000 \times 6$$
$$W = 1{,}080{,}000{,}000$$

1,080,000,000 acres

2. 60 percent of total commercial woodland acreage (1,080,000,000) is in small holdings.

60% x 1,080,000,000 = 648,000,000 acres

3. 1/2 of 648,000,000 acres is in 40-acre tracts.

1/2 x 648,000,000 = 324,000,000 acres are in 40-acre tracts.

324,000,000 ÷ 40 = 8,100,000 40-acre tracts

4. 1/20 of 1,080,000,000 burn. (Let B = burn)

1/20 x 1,080,000,000 = B
54,000,000 = B 54,000,000 acres

PURPOSE: To increase awareness of problems surrounding litter and garbage by graphing and calculation exercises.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics

REFERENCE: Environmental Education Instructional Unit: Pollution. Department of Public Instruction/ North Carolina Department of Public Education, Raleigh, North Carolina, 1972-73. ED 092 377.

ACTIVITY:

Ask students to bring 3-1/2 pounds of litter to school.

To the Teacher: Assign this 2 or 3 days in advance or give them a weekend to collect it. This may come from their home or community.

- Sort this material on a table, placing similar items together.
- Make a bar graph and record the findings by weight.

Use the graph when needed to answer the following questions:

a. How many types of litter did you find?

b. Which was the most common type?

c. Where would this type most likely be found?

d. Which was the least common type?

e. What is the percent of each type of litter collected?

f. What is the difference between litter and garbage?

g. Which items are garbage?

h. Which is the most harmful, litter or garbage, to our environment? Why?

i. If each student represents an average household producing approximately 20 pounds of garbage each day, how much would the class produce in 1 week? How much in 1 year?

j. How many tons of garbage would be produced by the class in 1 year?

k. If this average increases by 3 lbs. by 1990, how much garbage will be produced by this class in 1 week? In 1 year?

l. What will be the percent of increase for 1 week? For 1 year?

m. How much litter does the class create in 1 week, based on the national average of 3-1/2 lbs. per person per day? A month? A year?

n. Let each student, using his own family, calculate similar answers.

o. What are the totals for the class?

FOLLOW-UP ACTIVITY:

Devise a way to dispose of the litter in the classroom.

To the Teacher: Use a system students suggest.

--Where would they take it? Can the school handle it or do they need to take it to the city disposal?

(Students will need to consult the maintenance staff or janitor to find out what system the school uses to get rid of litter and garbage.)

--Is disposing of the litter the only problem caused by the collection in the classroom?

--What problems does disposal create with air, water, and land?

--Does the school have an incinerator?

--What kind of pollution does an incinerator create?

--What happens to the items that do not burn?

--What items containing natural resources and minerals are being thrown away? (paper, tin, glass, etc.

--Which items can be recycled?

--What is the process of recycling?

--Is there a recycling plant or organization in the community?

ANSWERS TO PROBLEMS:

e. To determine percentage by weights.

(No. of lbs. of particular kind ÷ No. of lbs. of <u>all</u> kinds) x 100%.

Example: Suppose from 50 lbs. collected, 3 lbs. are in cans.

$(3 \div 50) \times 100\% = (300 \div 50)\% = 6\%$

Cans: 6%

i. To compute weekly amount for class. (N = number of students in class)

$(N \times 20) \times 7 = N \times 140$ lb. per week

Using 52 weeks = 1 year

$(N \times 140) \times 52 = (7280 \times N)$ lb.

j. Using 1 lb. = $\frac{1}{2000}$ ton

(7280 x N) pounds x $\frac{1}{2000}$ tons per pound = (3.64 x N) tons

k. (7 x 3) + (140 x N) lb.

52 (21 + 140 x N) lb.

1. $(3 \div 20) \times 100\% = (300 \div 20)\% = 15\%$

Weekly: $\frac{161N - 140N}{140N} \div \frac{21N}{140N} = 15\%$

Yearly (by tons): $\frac{4.186N - 3.64N}{3.64N} \div \frac{.546N}{3.64N} = 15\%$

m. Weekly: (3-1/2 x 7 x N) lb. = 24.5N lb.
Monthly: (30 x 3-1/2N) lb. = 105N lb.
Yearly: (12 x 105N) = 1260N lb.

PURPOSE: To measure the velocity, volume and capacity of a stream.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics

REFERENCE: Environmental Center For Our Schools: Curriculum Guide: Grades 4, 5, 6. Springfield Public Schools, Springfield, Massachusetts, 1971. ED 063 151.

ACTIVITY:

Take your class to an area where there is a river or stream.

Station one child on the river bank.

Station another child about 50 feet upstream and ask him/her to toss a stick in the water.

Record the length of time it takes for the stick to float to where the first child is standing.

Compute the velocity with these known facts:

Velocity = distance traveled divided by length of time.

. $V = D \div T$

Discuss the following:

How does the speed of moving water change the earth's surface?

How does the speed of a stream affect the animals living there?

Can all water animals live in a fast moving stream? Why not?

Divide the class into groups of 3 or 4 students.

Give each group a yardstick and tape measure.

Ask each group to measure the width of stream in several places (20-50 feet) and find average width (A.W.).

Next, each group measures the depth of stream in several places and finds average depth (A.D.).

Write the formula Volume = A.W. x A.D. x L (length) on teaching board and help group compute the volume of the stream.

Ask what "volume" means (section of stream has certain amount of room--80 square feet, for example). Since stream is not still, it can hold more water over a period of time. This is the capacity of a stream.

Discuss the following:

1. Why is it important to know the amount of water a stream or any body of water holds?

2. Does the amount of water change from season to season?

3. Does the riverbed ever change? When?

PURPOSE: To practice compass and mapping skills as well as vocabulary development in an outdoor setting.

LEVEL: Elementary-Junior High School

SUBJECT(S): Mathematics
Language Arts

REFERENCE: Environmental Center For Our Schools: Curriculum Guide: Grades 4, 5, 6. Springfield Public Schools, Springfield, Massachusetts, 1971. ED 063 151.

ACTIVITY:

Hike group to special area and seat in circle.

Ask students to respond with one-word descriptions of the word BEAUTIFUL. List these as given on the teaching board. Circle the words the group agrees constitute beautiful.

Use the same procedure for the word UGLY. There will be disagreements as to what constitutes ugly or beautiful, but the group will agree on certain elements. Circle these words.

Divide children into at least two groups. One group is to find a BEAUTIFUL SPOT within indicated boundaries, the other, an UGLY SPOT. Using the student materials, each group is to draw a map of how to get to their spot.

Upon signal, both groups return, exchange maps, and try to locate each other's spots.

Hold a class discussion with questions such as:

1. Why was this spot chosen as beautiful or ugly?
2. Were you able to follow the map?
3. Could the map be improved?
4. What other places have you seen in the park that you thought were beautiful or ugly?

Now, instruct your students to find a nice private spot outdoors--all their own--where each can be comfortable to just sit and listen.

Ask them to close their eyes to sharpen their sense of hearing.

List all the sounds they can hear and identify.

Allow 10 or 15 minutes for this activity. Stress that absolute quiet is essential.

Signal the children to regroup for discussion. List on the teaching board all variety of sounds heard in the out-of-doors.

How does the out-of-doors make you feel?

List expressions of feelings on the teaching board.

Junior High School

BASIC SKILLS ACTIVITIES

65/66 68

PURPOSE: To sharpen writing skills in expressing feelings and moods.

LEVEL: Junior High School

SUBJECT: Language Arts

REFERENCE: Environmental Education: Energy-Transportation: Grades K-8. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 821.

ACTIVITY:

Ask your students to choose and complete one of the following tasks:

1. Read Robert Frost's "Stopping by Woods on a Snowy Evening." How has the author gotten around? Compare his mode of transportation to car travel. What is the difference in tempo--mood--things felt and expressed? Try to write something of your own evoking a mood corresponding to a mode of travel.

2. Read the poem "You Are on U.S. 40 Headed West" by Vera White (America Forever New, Sara & John E. Brewton, Thomas Crowell Co., Pub., New York, 1968, p. 234). This road was dreamed of by Thomas Jefferson. Look up the road on a map. How does the poem make you feel? Write a poem about a long trip you have taken. Don't worry about words that rhyme. Work for the feeling you had.

PURPOSE: To use mathematics to solve practical outdoor problems.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: Suggested by Stephen C. Bell. Murray State University-Teachers' Workshop in Environmental Education. Youth Station, Land Between The Lakes, 1971. ED 077 696.

ACTIVITY:

The following all use basic mathematics skills to solve out-of-doors problems:

Time-telling with stick

a. find a straight stick approximately 2' in length and place upright in the sunlight
b. locate North with a compass
c. with the stick as center, sketch a circle
d. make a clockface with 12 being at the North point
e. read the time from the shadow (works well between 9:00 a.m. and 3:00 p.m.)

Determining height of tree with ratio

a. use yardstick and determine length of its shadow
b. measure shadow of tree
c. formula:

$$\frac{\text{length of yardstick}}{\text{length of yardstick shadow}} \qquad \frac{\text{length of tree}}{\text{length of tree shadow}}$$

Determining height of tree without sunlight

a. measure a student in your class
b. stand the student of known height against the tree you wish to measure
c. hold a pen vertically between your thumb and forefinger at arm's length
d. position yourself in such a way that the student appears to be the same height as the pen
e. estimate the number of pen lengths to the tree top by moving pen up vertically
f. figure the height of the tree by the number of person heights

PURPOSE: To plan and calculate the cost of a trip.

LEVEL: Junior High School

SUBJECT: Mathematics

REFERENCE: Environmental Education: Energy-Transportation: Grades K-8. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 821.

ACTIVITY:

Ask your students to choose and complete one of the following tasks:

1. On a map, plot a trip from one city to another or one state to another and decide how you would get there. (You may need to call a train station or bus terminal.) Figure the cost of the trip. If you plan to use a car, compute the miles per gallon and the cost per gallon of gasoline, plus tolls and other fees. What is the mileage you intend to cover?

2. Plan a vacation trip to another state. How would you get there if you couldn't use your car? Would you go by train, bus, plane or boat? Find out the actual cost of two ways of going, then select the one you would prefer. Consider such items as baggage you would need, time it would take, etc. Also, how would you get from the train station or air field to your camp or hotel? Make a complete report of your trip. Include a map which you have drawn, plus your calculations.

PURPOSE: To learn a method of measuring distance across some natural barrier in which direct measurement is difficult.

LEVEL: Junior High School

SUBJECT: Mathematics

REFERENCE: Suggested by Ronnie Moffitt, Murray State University Teacher's Workshop in Environmental Education, August 1973. ED 100 677.

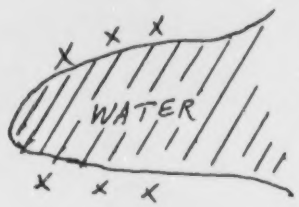
ACTIVITY:

Explain to or review with your class the Pythagorean Theorem used in determining the length of one side of a right triangle when two sides are known.

Explain or review the method used to extract the square root of a number.

Explain the use of a compass to shoot an azimuth and how this concept can be used to construct a 90-degree angle at a particular point.

Take your class outside to the school yard or better still to an area that has a water inlet. Divide the class into three groups. Set three stakes on each side of a real or simulated inlet as shown below:



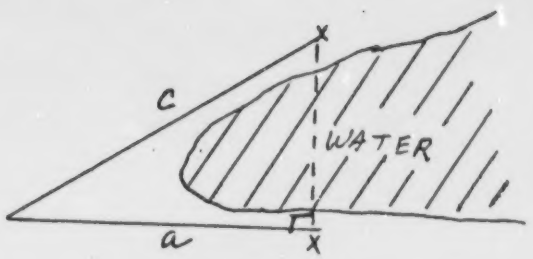
Assign each group a set of two stakes, give them a third stake and a hammer.

Have each group determine the distance between their two stakes using the method depicted below.

$$c^2 = a^2 + b^2$$

$$b^2 = c^2 - a^2$$

$$b = \sqrt{c^2 - a^2}$$



Upon return to the classroom discuss the need for such means of indirect measurement.

PURPOSE: To learn a method of measuring indirectly the height above the ground of an object.

LEVEL: Junior High School

SUBJECT: Mathematics

REFERENCE: Suggested by Ronnie Moffitt, Murray State University Teacher's Workshop in Environmental Education, August 1973. ED 100 677.

ACTIVITY:

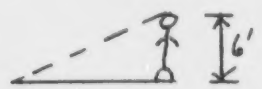
On a sunny day, take your class out-of-doors to measure the height of an object such as a flagpole, tall tree or telephone pole.

Ask students to measure the length of the shadow cast by the chosen object.

Also, measure the length of a shadow cast by a person of known height at the same time as the measurement for the chosen object

Set up a ratio/proportion for the above as shown in the following example.

Example: A man 6 feet tall casts a shadow of 10 feet while the silo casts a shadow of 100 feet.



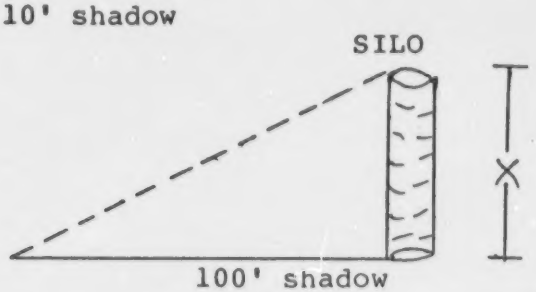
10' shadow

SOLUTION

$$\frac{6}{10} = \frac{x}{100}$$

$$6x = 600$$

$$x = 60$$



100' shadow

Discuss the concept of similar triangles.

PURPOSE: To estimate the energy consumed by common electrical appliances.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: A Sourcebook of Applications of School Mathematics. Mathematical Association of America and the National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia 22091, 1980. Reprinted with permission of NCTM.

ACTIVITY:

Find the maximum wattage ratings of the electrical appliances in a typical family kitchen (yours or someone elses).

a. If all these appliances were running at maximum wattages at the same time, what would the total wattage be?

b. Determine the total current. (Current, in amperes, is related to power in watts by the formula current x voltage = power, where the voltage is measured in volts. The approximate voltage in most household circuits in the United States is 115 volts.)

c. A circuit breaker or fuse protects the electric lines in most houses from currents in excess of 15 or 20 amperes, depending upon the size of the wire. How many 20-amp circuits (circuits carrying at most 20 amps of current each) would be necessary to operate all the appliances at once?

d. Estimate the amount of time that each appliance is operated in a typical month. If energy costs 6¢ per kilowatt hour (one kilowatt for one hour), what is the cost of the energy used to operate these appliances?

SOLUTION

Sample data for reference:

mixer	150 w
can opener	100 w
blender	600 w
coffee maker	1400 w
toaster	800 w
frying pan	1200 w
slow cooker	150 w
waffle maker	1000 w
dishwasher	1000 w
garbage disposal	500 w

The range and oven are usually on a separate 220-volt line.

Answers to questions for sample data:

a. 6900 watts

b. 60 amps

c. 3 circuits

d. answers will vary

PURPOSE: To become aware of the amount of water used by various sectors of society by calculating average water uses.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: Pollution: Problems, Projects and Mathematical Exercises, Grades 6-9. Wisconsin Department of Public Instruction, Madison, Wisconsin 53702. ED 046 746.

ACTIVITY:

The following problems are all related to the amount of water it takes to maintain our standard of living.

1. To meet over all needs of the average community a water utility must supply 150 gallons of clean water per person each day. Use the population of your community to compute the amount of water that must be produced by the water utility:

   a. each day
   b. each week
   c. each month
   d. each year

2. For residential purposes the average American uses 60 gallons of water each day. As an average American, how much water would you use in a week? (420 gal.)

3. Commercial operations use about 20 gallons of water per day per person. How many days of commercial operation are needed to use 600 gallons of water per person? (30 days)

4. About 10 gallons of water per day per person is lost through breaks in pipelines. In one year how much water is lost with no benefit to the people in your community?

5. If each day a 2-year-old steer weighing 700 pounds drinks 12 gallons of water, how many gallons will be required to water 1,000 steers in a day? (12,000 gal.)

6. If it requires 1,400 gallons of water to produce a dollar's worth of steel, how many gallons would be used to produce $50 worth of steel? (70,000 gal.)

7. Industry uses on the average 50 gallons of clean water per day per person from the public system. It takes about 500 gallons of water to produce one gallon of gasoline. If all of the industry's water per day was used to produce gasoline, then how many gallons of gasoline could be produced in a community of 50,000 people? (5,000 gal.)

8. The paper industry needs about 90,000 gallons of water for each ton of paperboard produced.

   a. How many gallons of water does it take to produce one pound of paperboard? (45 gal.)

   b. If 53 million tons of paperboard are produced each year by the paper industry, then how many gallons of water would be used each year? (477×10^{10})

PURPOSE: To become aware of the quantity of aluminum used in the United States.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: Pollution: Problems, Projects and Mathematical Exercises, Grades 6-9. Wisconsin Department of Public Instruction, Madison, Wisconsin 53702. ED 046 746.

ACTIVITY:

Ask your students to compute the following problems to get an idea of the quantity of aluminum we use in our daily lives.

According to a 1969 estimate, people in the United States use approximately 30,000,000,000 cans a year.

a. If we estimate that the population of the United States for that year was 202,000,000, what would be the average number of cans used per person? (to the nearest whole number) (149 cans)

b. If these are aluminum cans and on the scrap market they are worth 1/2¢ each, what would be the worth of the cans an average individual uses in one year? (to the nearest whole cent) (75¢)

c. For your class?

d. For your community? (use rounded numbers for the population of your community)

e. If the average life span is 75 years, how many cans would a person use in a lifetime? (11,175 cans)

PURPOSE: To investigate the connection between air pollution and incidences of pneumonia.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: Pollution: Problems, Projects and Mathematical Exercises, Grades 6-9. Wisconsin Department of Public Instruction, Madison, Wisconsin 53702. ED 046 746.

ACTIVITY:

In 1949 New York City had the most polluted air and the highest death rate from pneumonia in the State of New York--31.5 per 100,000 population. In eleven upstate cities with much cleaner air, the rate was only 23.9 per 100,000. In rural areas, where pollution was least, the death rate was lower still--16.9. In 1959, all rates increased. Then New York City had 50.6 pneumonia deaths per 100,000; the upstate cities had 38.6 and the rural areas had 29.2.

a. What was the rate of increase in New York City from 1949 to 1959? (19.1 per 100,000)

b. How much higher was the rate in New York City than the rural area in 1949? (14.6 per 100,000)

c. What was the rate of increase in the upstate cities from 1949 to 1959? (14.7 per 100,000)

d. How much higher was the rate in New York City than the rural areas in 1959? (21.4 per 100,000)

PURPOSE: To solve word problems pertaining to the effects of the newspaper industry on our forests, using fractions and multiples.

LEVEL: Junior High School

SUBJECT(S): Mathematics

REFERENCE: Project I-C-E. Environmental Education Guide: Mathematics 8. 1927 Main Street, Green Bay, Wisconsin. ED 100 669.

ACTIVITY:

Give your students the following information: It takes 17 trees to make a ton of newsprint. As a class, solve the following problems:

1. How many trees would it take to make 51 million tons of newsprint?

2. 53 million tons of newsprint?

3. 119 million tons?

4. 74 million tons?

5. 1 billion tons?

Have the students use the above information and weigh all of the magazines and "junk" mail they receive. How many trees or parts of trees were used?

Next, ask students to collect the newspaper used in their home for a week. After the week, weigh this newspaper and determine the approximate weight of the newspaper their family would use in a year by multiplying the above weight by 52. How many trees were used in making that amount of newsprint?

Next, ask students to figure out how many trees were used in making the newspaper in their block for a year by multiplying by the number of families living in the block.

Finally, figure out how many trees were used in making the newspaper in their town for a year by multiplying by the number of families living in the town.

Students can contact local and nearby newspapers to see how many trees they use in publishing their newspapers in a year and report their findings in the form of a written report. This information will have to be computed on the basis of the number of tons of newsprint used by the publisher.

PURPOSE: Through site survey, determine service capacity of a restaurant, hypothesize inconvenience factors in case of overload, and from the experiences, provide a definition for "carrying capacity."

LEVEL: Junior High School

SUBJECT(S): Mathematics
Language Arts

REFERENCE: Project I-C-E, Carrying Capacity Series, 1927 Main Street, Green Bay, Wisconsin.

ACTIVITY:

Give your students the following assignment and list of instructions:

1. Arbitrarily select two local restaurants and in an on-site visit determine for each the following:

	Restaurant A	Restaurant B
a.	Number of tables/booths/counter seats	
b.	Actual seating capacity	
c.	Number of waiters/waitresses	
d.	Number of cooks	
e.	Average customer service time	
f.	Average capacity customer turnover per hour	

2. Interview Owner/Manager

   a. Service reaction if 100 persons came in at the same time:

      Restaurant A _____

      Restaurant B _____

b. Service capability if notified in advance:

Restaurant A _____

Restaurant B _____

3. Summarize any human inconvenience factors that might result for the management or the clientele if 100 persons constitute an overload in terms of capacity turnover in a one-hour period:

4. On the basis of this practical exercise, provide your definition of "carrying capacity":

Junior-Senior High School

BASIC SKILLS ACTIVITIES

83/84 85

PURPOSE: To write concrete poetry in three forms about things in nature.

LEVEL: Junior-Senior High School

SUBJECT(S): Language Arts

REFERENCE: Suggested by Lynn Hodges. Murray State University Teachers' Workshop in Environmental Education. Youth Station, Land Between the Lakes, 1971. ED 077 696.

ACTIVITY:

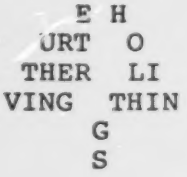
Ask students how we communicate. List different ways. If students do not include "writing," "pictures" or "drawings," add to list.

Ask students to decide the oldest known types of writing (hieroglyphics, cuniforms). How is this writing different from ours? Is there a way we could communicate more in our writing?

Tell students that you want them to try a new form of communication which can communicate more than either writing or drawing. Begin with examples: Type 1 - Visual: The visual form of concrete poetry simply makes a statement, but by the arrangement of the words, directs the reader towards a particular frame of reference.

Example - Type 1

1.

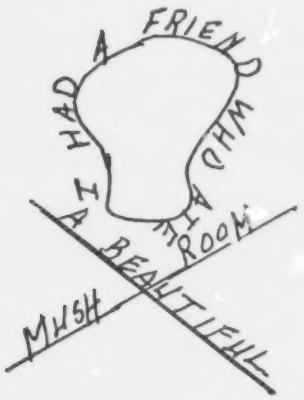
2. 

Type 2 - Story:

The story form of concrete poetry make a statement about the action of some thing or person, and by its visual arrangement, completes the action and reveals an ending.

Examples - Type 2

1.



2. I tOUCHed a bUG.

3. I Sneaked up on a frOg.

Type 3 - Factual:

The factual form of concrete poetry is the expression of a common idea, fact, or image by use of the spatial or place-on-the-page relationship between words. The form is the most abstract of the three forms of concrete poetry.

Examples - Type 3

1. * Water
fish swim

2. * L
Ground
I

3.

"Life"	"Death"
Me	Grass
Grass	Ground
Ground	Me

4. CO_w

*1. Fish swim under water.

2. Oil from below ground to above ground.

3. "Life" - I'm above the grass, above the ground.
"Death" - I'm below the ground, below the grass.

Discuss each example and type.

After the students have seen and discussed the examples, ask if anyone has thought of another example. Put each example on the board and ask students to tell the type or form.

Have each student do two examples of each type using something in the natural environment as a topic.

Have the student show and tell or discuss their concrete poems.

PURPOSE: To write paragraphs that demonstrate use of environmental perspective and/or point of view in the writing process.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Suggested by Sarah Skaates, Language Arts Teacher, Blendon Jr. High School, Westerville, Ohio.

ACTIVITY:

One way to approach Inside/Outside Paragraphs is to wait until a day with a good snowstorm. Station class members at windows and instruct them to make as many notes as they can about the snowstorm (or snowfall). Remind them that they should be aware of sensory details of what they are observing as well as of their own surroundings. Next, have class dress suitably and go outside into the storm for a few minutes. They will not actually record notes while outside, but should be helped to observe what they experience when they move from inside the building to a protected area near the building to an exposed area where the full effect of the storm can be felt. Once back in the classroom, the class should now record notes on the first-hand experience with the snow.

Discuss with the class the differences in watching a snow or other weather activity from "Inside" compared to being "Outside" in it. Help them determine appropriate and interesting ways in which they can handle their notes and use them to compose two paragraphs. Both paragraphs should be about the snowstorm, but one will be the "Inside" view of it and the other will be the "Outside" experience. Spend as much time as seems needed in discussion and illustration, then assign the Inside/Outside Paragraphs to be completed for the next day's class. Remaining class time should be used as work time.

PURPOSE: To recognize and record sensory environmental data can then be used as raw material for creative writing.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Suggested by Sarah Skaates, Language Arts Teacher, Blendon Jr. High School, Westerville, Ohio.

ACTIVITY:

Explain to your class that they will be going on a 15-minute "still hunt" to collect as many sensory impressions of the out-of-doors as they can. They should strive to consider all senses and to list impressions for each. (Taste may be more difficult than the others.) Instruct them to simply jot down notes rather than to put thoughts into sentences. Suggest that where possible they use their most descriptive language in their notes, but not to labor too long over any one impression.

Escort class outside building and allow them to choose their observation spots within a practical distance. Allow 15 minutes for them to be still and observant, then return to classroom.

After their return, instruct them to review their impressions and choose those which are favorites or which are most vividly descriptive. The next step is to compose one or more bits of short free verse (or haiku or cinquain) to express poetically the sensory image(s) collected.

PURPOSE: To sharpen observation skills and to develop a sense of correlation between visual imagery expressed in words and in shape.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Suggested by Sarah Skaates, Language Arts Teacher, Blendon Jr. High School, Westerville, Ohio.

ACTIVITY:

To write Tree Poems, students should have a working supply of notes describing trees. If these are not available from a previous writing exercise, students should be instructed to choose a tree to observe closely. They should list descriptive words and phrases which fit that specific tree and the surrounding landscape. For instance, they might note "branches scratching holes in the sky" or "snow slipping off slope-shouldered boughs" along with one- or two-word descriptors. As the students make their written notes they should also observe the general shape and structure of their trees. Allow approximately one-half the class period for these observations if necessary.

Suggest that students experiment with arranging their descriptors on the page in such a way as to suggest the shape of the tree they studied. Some students may find it easier to lightly sketch the outline or skeleton of the tree on paper first, then print in the words where they will fit most effectively. At this stage students may think of new ways to express the images they had recorded during observation. Encourage them to work imaginatively so that the visual "picture" of the tree is created both by the arrangement and the meaning of the words. Allow students to continue working on the project as homework if time and interest indicate it.

PURPOSE: To provide students with an exercise to help them sharpen their creative writing skills.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Carl Brown, editor. Idaho Energy Conservation Resource Guide: Language Arts for Grades 7-12. Idaho Office of Energy, Boise, Idaho. ED 182 136.

ACTIVITY:

Assign students to read a futuristic or Utopian type of book such as:

WHY I WENT TO THE WOODS by Thoreau
WALDEN II by B. F. Skinner
1984 by George Orwell
BRAVE NEW WORLD by Aldous Huxley
TUNNEL IN THE SKY by Robert Heinlein
TIME OUT FOR THE STARS by Robert Heinlein

After students have had an appropriate amount of time to complete their reading, ask them to choose one of the following writing projects:

a. Design your own Utopia. Describe the government, schools, living quarters, jobs, transportation, use of leisure time and family life.

b. Imagine your own Utopia and write a short story using it for a setting.

c. Pretend to be a member of your Utopia and write a series of journal entries about your life.

d. Write a letter to a friend trying to persuade him/her to move to your Utopian community.

PURPOSE: To help students develop confidence in extemporaneous oral expression.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Carl Brown, editor. Idaho Energy Conservation Resource Guide: Language Arts for Grades 7-12. Idaho Office of Energy, Boise, Idaho. ED 182 136.

ACTIVITY:

Using an impromptu speech method, ask your students to deliver a 2-3 minute speech using these topics or related student-originated topics:

1. A gas tax on large automobiles.
2. Minimum age for driver licenses extended to the age of 19.
3. Automobile ownership limited to one car per family.
4. Gas rationing.
5. Private ownership of automobiles prohibited.
6. Supermarkets and all industry must close at 7:00 P.M. and on Sundays.
7. During a water shortage, what is the highest priority: the farmer, industry, private homes, small business, medical services?
8. Should industry be allowed to pour waste into our rivers and lakes?
9. The cost of actually owning and driving an automobile.
10. The desirability of nuclear power.

PURPOSE: To enable students to arrive at and be able to state a personal conservation ethic.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

REFERENCE: Carl Brown, editor. Idaho Energy Conservation Resource Guide: Environmental Education for Grades 7-12. Idaho Office of Energy, Boise, Idaho. ED 182 134.

ACTIVITY:

Ask each of your students to develop a written description of his/her own "Personal Energy Conservation Ethic." The purpose of the "Ethic" is to guide the student's daily use of energy.

Before the actual writing, the students should discuss the following, then keep them in mind when writing their individual ethics:

1. What is an ethic?
2. What is energy conservation?
3. What are the differences between essential needs and nonessential desires?
4. What are some examples of both good and poor energy conservation actions?
5. What are you willing to do for the sake of energy conservation?

After it is written, students may want to share their ethic with the class. The class could then discuss the following:

1. What factors might change your energy conservation ethic in the future?

2. How can you encourage other people to develop and practice an energy conservation ethic?

PURPOSE: To review critically newspaper editorials which express viewpoints on environmental issues.

LEVEL: Junior-Senior High School

SUBJECT: Language Arts

ACTIVITY:

Ask your students to check the editorials in your local newspaper(s) that express viewpoints on controversial environmental issues. After they have collected a sufficient number of editorials, ask them to carefully read the editorials, state the issue addressed and list any convincing points the author makes to influence the reader. Have students research the issue to determine if the author's points are substantiated.

PURPOSE: To look at things as they might have been, are, or could be and represent this sense of perception in a creative language form.

LEVEL: Junior-Senior High School

SUBJECT(S): Language Arts

REFERENCE: Project I-C-E; Values and Attitudes Series, 1927 Main Street, Green Bay, Wisconsin.

ACTIVITY:

Ask your students to visit the site of any abandoned building and to--without getting into a trespassing situation--on site, view the building and premises as best possible. Select, individually, a vantage point of the building and site that has some appeal. Ponder the site perspective and do a creative writing in a chosen form on one of the following points:

a. What it once was-

b. What it now is-

c. What it still could be-

d. Describe how you feel about the fate of the building-

If artistically inclined, do a sketch of the building, site, or any special aspect of it that is appealing.

Many such buildings stand empty for a long time and fall into disrepair. What might be the immediate disposition of this building and site?

PURPOSE: To calculate the importance of energy costs to the family budget.

LEVEL: Junior-Senior High School

SUBJECT: Mathematics

REFERENCE: Carl Brown, editor. Idaho Energy Conservation Resource Guide: Mathematics for Grades 7-12. Idaho Office of Energy, Boise, Idaho. ED 182 133.

ACTIVITY:

Teachers Note: This activity should be handled tactfully. Some families will not want to reveal their incomes. You can avoid this problem by using your income to illustrate the activity. Or you can "make-up?" incomes for imaginary friends.

1. Given the yearly family income and the fractional part of the income spent on energy, calculate the amount of money spent on energy.

   EXAMPLE: Income = \$14,000
   Energy = 1/20

   $$A = \frac{1}{20} \quad (\$14,000)$$

   $$A = \$700$$

2. Given net monthly income and the dollar amount spent for electricity, heat or gasoline, calculate the fractional part of the net income spent on these commodities.

   EXAMPLE: Net Income = \$750
   Electricity = \$30

   $$\frac{30}{750} = \frac{1}{X} \; ; \; 30X = 750$$

   $$X = \frac{750}{30} \; ; \; X = 25$$

   $$\therefore \quad 1/25 = \text{F.P.}$$

3. Given energy consumption rations under different conditions, determine the percent increase or decrease.

   EXAMPLE: Electricity = $60 August
   Electricity = $69 December

$$\frac{X}{100} = \frac{69 - 60}{60}; \quad X = 15$$

$\therefore$ 15% increase

4. Discuss how families can reduce their consumption of energy. Students can explain techniques used successfully by their own families.

Related Activities

1. Given a bar graph indicating the percentage of energy converted to useful work for different sources, determine the most efficient and least efficient sources.

2. Given a line graph comparing fuel consumption with speed of an automobile, determine the speeds for least consumption and greatest consumption.

3. Given the percentages of total residential energy consumed by household appliances, construct a bar graph of the information.

4. Given the average population of each of the past five decades and the average energy consumption of each decade, compute the percent increase in energy use per capita between any two decades.

5. Given the odometer reading at the beginning of one tank fill and the beginning of a second fill, and the quantity of the second fill, compute the miles per gallon or kilometers per liter.

PURPOSE: To calculate the effectiveness of different ways of conserving energy.

LEVEL: Junior-Senior High School

SUBJECT: Mathematics

REFERENCE: Carl Brown, editor. Idaho Energy Conservation Resource Guide: Mathematics for Grades 7-12. Idaho Office of Energy, Boise, Idaho. ED 182 133.

ACTIVITY:

Encourage a class discussion about the following:

1. How energy conservation affects the student.

2. How the student can get started on his/her own energy conservation program.

Give students the following problems relating to energy conservation and ask them to explain the effectiveness of the different conservation methods:

1. Given the average fuel consumption for an uninsulated home, and the average consumption for an insulated home, determine the percent decrease in consumption.

EXAMPLE: Insulated = 900 Gallons Oil
Uninsulated = 1600 Gallons Oil

$$\frac{X}{100} = \frac{1600 - 900}{1600}$$

$X = 43.75\%$

2. Given national potential energy savings in 10^{15} calories:

Thermostat set back (68° day/60° night)	.37
Water heating (120°)	.15
Air Conditioning (78°)	.03
Hot Water Use (1/3)	.12
Furnace Tune-up	.15
Air Conditioner Tune-up	.23
Insulated Ceilings	.18
Weather Stripping	.08
Storm Windows and Doors	.04

Determine the number of calories (in scientific notation) saved by each action and the total number of calories saved.

3. Given the roof areas of two buildings and the number of calories of solar energy received by one, determine the amount of solar energy received by the other.

EXAMPLE: Roof 1 = 1600 sq. feet
Roof 2 = 1200 sq. feet
Roof 2 receives 1.5×10^9 cal/year

$$\frac{X}{1600} = \frac{1.5 \times 10^9}{1200}$$

$X = 2 \times 10^9$ cal/year

4. Given the percent reduction in utility bills from the installation of solar heating panels, the current utility bill, and the cost of the installed solar unit, determine:

a - the new projected utility bill
b - time required to pay for the solar unit

EXAMPLE: Solar cost = $5000
Current bill = $700/year
Bill reduction = 60%

a - projected new bill = .40 (700)
= $280

b - time = $\frac{5000}{700-280}$

= 12 years

PURPOSE: To compare a car's energy performance with a bicyclist's energy performance.

LEVEL: Junior-Senior High School

SUBJECT: Mathematics

REFERENCE: Mark Wahl. Two Wheel Math: An Application Module. University of Denver Mathematics Laboratory Regional Center for Pre-College Mathematics, Denver, Colorado, 1974. ED 183 413. Reprinted with permission by University of Denver Mathematics Laboratory.

ACTIVITY:

Ask your students to complete the following work-sheet(s):

Cars use gasoline and people on bikes use food to get the energy to move. Before we can compare a car's performance with a bicyclist's performance, we have to talk about how how energy is measured.

ENERGY is usually measured in terms of how much HEAT it will make. We will have to spend some time now learning about units of energy.

The calorie and the joule are two small units of heat (energy)

1 joule = .24 calories

Which is bigger, a joule or a calorie? _____

About how many joules are there in a calorie? _____

Then there are large Calories (with a Capital C)

1 Calorie = 1000 calories = 4166 joules

A farmer might use up to 4,000 Cal in a hard day's work. How many joules of energy would he use up on such a working day? _____

Now, a person who uses up 746 joules every second is working very hard, whereas one who uses up 746 joules in an hour is barely moving. So ... TIME has to be taken into account when we spend energy.

a joule-per-second is a watt

746 watts = 1 horsepower

How many watts is 11 horsepower? _____

How many Calories-per second is a horsepower? _____

(Hint: Give an approximate fraction.)

Calculate the following:

1. A glass of whole cow's milk contains 660 calories of energy. How many joules is this? _____

   If a bicyclist burns up 373 joules per second (i.e., 373 watts or 1/2 horsepower), how long will a glass of milk allow him to pedal? _____

2. According to one calculation, a man on a bicycle uses 12.6 calories to travel 1 kilometer (assuming bike + rider = 84 kg). If he goes 24 km/hr. (a comfortable speed) it takes him how long to go 1 kilometer? ____min. or _____sec. Thus, our bicyclist uses 12.6 calories or _____joules in _____sec. This is _____joules per second; i.e., _____watts. Our bicyclist, therefore, is using energy about like burning a _____ watt light bulb.

3. A car, on the other hand, uses 1500 calories to travel 1 kilometer. Assume a speed of 48 km/hr. How long to 1 kilometer? _____min. or _____sec. The car uses 1500 calories or _____joules in _____sec. This is _____joules per second; i.e., _____watts. our car is burning _____200 watt light bulbs.

4. Compare the answers to 2 and 3. Draw a conclusion about riding bicycles.

PURPOSE: To learn two different ways to measure population changes.

LEVEL: Junior-Senior High School

SUBJECT(S): Mathematics

REFERENCE: Environmental Education Instructional Unit: Population, Grades 7-12. Department of Public Instruction/North Carolina Department of Public Education, Raleigh, North Carolina, 1972-73. ED 092 377.

ACTIVITY:

Give each student the Fox City Fact Sheet located on the next page. Explain to your students that there are several ways to measure population changes. One of them is to compute the difference from one period to another. Another way is to compute the rate of change.

Here is an example of each computation using the 1930-1940 period.

EXAMPLE:

Difference measure

last date 1940 population 21,313
first date 1930 population 17,093

ANSWER 4,220 increase

Rate of change

1940 21,313
1930 17,093

4,220

.247 - 25%
17,093 / 4,220.0
3 418 6
801 40
683 72
117 680
102 558
15 122

Now, ask students to complete the following exercises:

1. Find the periods (10 years each) of greatest and least differences.

FOX CITY FACT SHEET

POPULATION

Year	Number of People
1890	1,033
1900	4,610
1910	5,759
1920	12,871
1930	17,093
1940	21,313
1950	23,069
1960	37,276
1970	47,142

	Number of Autos	Trucks
1930	1,398	
1960	20,034	3,585
1970	32,705	5,932

$$\text{Birth Rate} = \frac{\text{total number of births per year}}{\text{total population}} \times 1{,}000$$

$$\text{Death Rate} = \frac{\text{total number of deaths per year}}{\text{total population}} \times 1{,}000$$

Rate of natural increase = birth rate - death rate

Projected rate of population increase = 24% per 10-year period

1980 = 58,456
1990 = 72,485

2. Find the periods (10 years each) for which the rate of change is greatest and least.

3. Were your answers to 1 and 2 the same?

4. If during the period 1970-1980 the difference remains the same as for 1960-1970, what would the 1980 population be?

5. If during the period 1980-1990 the difference is the same as for 1970-1980, what would the 1990 population be?

6. If the increase remains the same for each 10 year period, how long will it take for the town's population to reach 100,000?

7. If during 1970-1980 the rate of change remains the same, what will the 1980 population be?

8. If during 1980-1990 the rate of change remains the same as the 1970-1980 rate, what will the 1990 population be?

ANSWERS TO POPULATION EXERCISES:

1. The period of 1950-1960 was the greatest.
   The period of 1900-1910 was the least.

2. The period of 1890-1900 was the greatest.
   The period of 1940-1950 was the least.

3. No.

4.

47,142	1970 population		47,142	1970 population
37,276	1960 population		9,866	population growth
9,866	population growth		57,008	1980 population

5.

57,008	1980 population
9,866	population growth
66,874	1990 population

6. 100,000 desired population
47,142 1970 population

52,858 amount of growth needed to reach 100,000

52,858 (amount of growth needed to reach 100,000)

÷ 986.6 (average growth/1 year from 10 year growth in Problem #4) = 53+ so 54 years

7. 47,142 1970 population
.24 rate of growth from FACT SHEET

188568
94284

11314.08 projected growth

47,142 1970 population
11,314 projected growth

58,456 1980 population

8. 58,456 1980 population
.24 rate of growth from FACT SHEET

233824
116912

14029.44 projected growth

58,456 1980 population
14,029 projected growth

72,485 1990 population

PURPOSE: To determine efficiency of car operation, and consider data to calculate total miles driven, total fuel utilized and the annual cost per passenger for the cars in the school parking lot.

LEVEL: Junior-Senior High School

SUBJECT(S): Mathematics

REFERENCE: Project I-C-E, School Yard Series, 1927 Main Street, Green Bay, Wisconsin.

ACTIVITY:

We are always quick to point a finger at others, or discuss problems, environmental and other, when such do not impact on us personally/directly. Energy, in this case gasoline, is an impending crisis. This survey may just impact on us and then--"What can I do to lower energy consumption?"-becomes a personal question.

Give each student a copy of the worksheet on the following page. Assign students to teams of two or three each, and have each team designated for Car No. 1, Car No. 2, etc., in sequence. Students then are directed to school parking lot, either staff or student, and they then randomly select automobiles, or do all that are in the parking lot. Once they have selected the automobile and recorded basic descriptive data for Item #1, they must identify the owner, either staff or student, and by interview, obtain the information for Items 2 through 7. Once this information is available, students do the computations for Items 8 and 9.

Item #10 can then be done as a class and discussion directed to costs and fuel conservation.

STUDENT WORKSHEET TEAM MEMBERS: _____

_____

_____

CAR NO: _____

1. Make/Model: _____ _____

   Check one: Compact _____ Intermediate _____ Full Size

2. Number of cylinders: _____

3. Engine Horsepower Rating: _____

4. Average Miles Per Gallon of Fuel: _____

5. Average Fuel Cost (per gallon): _____

6. Average Round Trip Miles to Work: _____

7. No. of Passengers: _____

8. Figure fuel cost for each round trip:

   _____ ÷ _____

   Round trip miles ÷ Miles per gallon

   equals

   _____ x _____ = _____

   (Gallons used) x Cost per gallon = Cost per round trip

9. Cost per passenger:

   a) If one person travels, that daily cost is:

      The cost per year is (190) x (cost_____) = _____

   b) If more than one: (daily cost_____) ÷ (number of passengers_____) = _____ cost per passenger. The cost per year for each passenger is (190) x (daily cost _____) = _____

0. Additional activities:

   a) Compare results for all cars surveyed by the class:

      1) How many total miles driven each year by all cars surveyed? _____

      2) How many gallons of fuel are used each year by cars surveyed? _____

3) What is the total cost per year to operate all the cars surveyed? _____

4) Which cars are more efficient (cost less to operate)? _____

b) How could gasoline fuel be conserved and money saved? Discuss.

PURPOSE: To estimate the size of the population of passenger pigeons at the height of their existence in the U.S.

LEVEL: Junior-Senior High School

SUBJECT(S): Mathematics

REFERENCE: A Sourcebook of Applications of School Mathematics. Mathematics Association of America and National Council of Teachers of Mathematics, 196 Association Drive, Reston, Virginia 22091, 1980. Reprinted with permission of NCTM.

ACTIVITY:

The passenger pigeon, once extremely numerous in this country, is now extinct. Scientists like to be able to estimate the size of the population at various times in the past, but data are scarce. One observer wrote: "Taking for example a column about 500 yards in breadth--which is much below the ordinary measurement--and allowing three hours composing it to accomplish their flight, as its swiftness was 500 yards a minute, ... Supposing now that each square yard was occupied by ten pigeons, we may conclude that ... ." What may we conclude about the size of the flock?

SOLUTION

450,000,000 birds. The observer may have over-estimated the numbers. On the other hand, it is estimated that in the early 19th century there were 60,000,000 bison in the United States.

PURPOSE: To graph the production rates of fossil fuels in the U.S. for a given year and project how these rates may change in the future.

LEVEL: Junior-Senior High School

SUBJECT: Mathematics

REFERENCE: Environmental Education: Energy-Technology: Grades 7-12. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 822.

ACTIVITY:

The following are estimates of the reserves of fossil fuel in the United States in 1968. Coal--1580 billion tons remaining, 1968 production rate 0.55 billion tons/year. Oil--165 billion barrels, 1968 production rate 3.4 billion barrels/year. Natural gas--19.3 trillion cubic feet/year.

If we continue to use these fossil fuels at the same rate as we did in the past, how long will they last? Draw a graph for oil, coal and natural gas that shows the production rate since 1900 to the year 2050. Along with your graph, try to answer some of the following questions.

Since 1968, discoveries have been made of more resources (such as the north slope oil field in Alaska).

How many barrels of oil were found in Alaska?

How long will this extend our supplies of oil?

Do you think that the production rate has remained constant since 1900?

Do you think it will remain constant in the future?

How will price increases such as recent ones for all of the fossil fuels affect production rate?

How do you think your graphs of the production rates will be altered in the future?

PURPOSE: Following a survey outline, determine the level of satisfaction with your community's water supply.

LEVEL: Junior-Senior High School

SUBJECT(S): Mathematics
Language Arts

REFERENCE: Project I-C-E, Water Series, 1927 Main Street, Green Bay, Wisconsin.

ACTIVITY:

Ask your students to participate in the following assignment:

1. Randomly select and interview four residents on either side of one city block on the following points:

	Residence 1	Residence 2	Residence 3	Residence 4
a) Number of persons in:	_____	_____	_____	_____
b) Average monthly water usage:	_____	_____	_____	_____
c) Average monthly cost:	_____	_____	_____	_____
d) Is cost reasonable:	_____	_____	_____	_____
e) Rate water quality:	_____	_____	_____	_____
f) Rate Water Department service:	_____	_____	_____	_____
g) What household function uses the most water:	_____	_____	_____	_____
h) What water conservation measures are used:	_____	_____	_____	_____

Elaborate if necessary.

2. Pose to each resident respondent the question--"How do you see the need for water conservation?" Record verbatim:

Residence 1:

Residence 2:

Residence 3:

Residence 4:

3. Interpret and summarize the results of this survey.

Senior High School

BASIC SKILLS ACTIVITIES

PURPOSE: To review critically and react in writing to a work that projects future society and prepare a debate supporting individual viewpoints.

LEVEL: Senior High School

SUBJECT: Language Arts

REFERENCE: Environmental Education: Energy-Technology: Grades 7-12. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 822.

ACTIVITY:

A number of books have been written over the past few years known as "Doomsday Books" because of their projections about future societies. Ask your students to read one of these books (such as "The Limits to Growth" by D. Meadows, et al., University Books; "World Dynamics" by Jay Forrester, Wright-Allen Press; and "Urban Dynamics" by Jay Forrester, M.I.T. Press) and write a reaction paper to the book that includes your opinion of the author's views, whether or not you find holes in his arguments, and what your projection of the future is.

As a follow-up, ask your students to prepare a debate for an assembly, P.T.A., etc., based on the following statement--"To make our country self-sufficient energy-wise, it is imperative to move full speed ahead on offshore oil drilling (and/or solar energy, and/or nuclear energy, etc.)."

PURPOSE: To calculate the insulating properties of various building materials.

LEVEL: Senior High School

SUBJECT(S): Mathematics

REFERENCE: A Sourcebook of Applications of School Mathematics. Mathematics Association of America and National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia 22091, 1980. Reprinted with permission of NCTM.

ACTIVITY:

The resistance of building materials to heat loss is expressed as an 'R' value. Materials with high R values are good insulators. The following table gives the R values for some materials:

Material	Thickness (inches)	R value
Plywood	1/2	0.63
Fiberglass	2 1/2	7.00
Rockwool	3 1/2	10.00
Brick	4	0.42
Styrofoam	1 1/2	7.45

It is difficult to compare these materials because the thicknesses are different.

Assume that for each of the above materials the R value of a sample is proportional to the thickness. That is, the R value of plywood 1/4" thick is 0.315 and of plywood 1" thick is 1.26, for example. Find the R values for a standard 3" thickness of each material; and then rank the materials from best to worst.

SOLUTION

Rank	Material	R value for 3" thickness
1.	Styrofoam	14.9
2.	Rockwool	8.57
3.	Fiberglass	8.4
4.	Plywood	3.78
5.	Brick	0.315

Comment: Most people are surprised by the very poor insulating properties of brick.

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PURPOSE: To calculate the number of Christmas trees that could be planted on one acre of land.

LEVEL: Senior High School

SUBJECT(S): Mathematics

REFERENCE: A Sourcebook of Applications of School Mathematics. Mathematics Association of America and National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia 22091, 1980. Reprinted with permission of NCTM.

ACTIVITY:

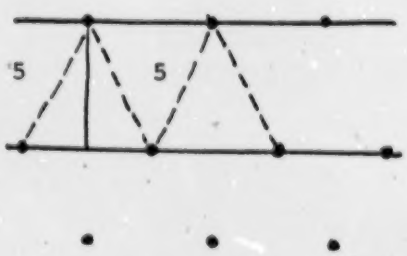
Trees grown for sale as Christmas trees should stand at least five feet from one another while growing.

a. If trees are grown in parallel rows, what is the smallest allowable distance between rows?

b. How many trees per acre could be grown this way?

SOLUTION:

a. Smallest distance between rows is attained when rows are staggered and adjacent trees are vertices of equilateral triangles. The distance will then be, by the Pythagorean Theorem,



$$\sqrt{5^2 - (5/2)^2} \approx 4.33'.$$

b. The area per tree is the area of two of the equilateral triangles, or 2x1/2x5x4.33 = 21.66 sq. ft. Since there are 43,560 sq. ft. in an acre, the number of trees per acre would be 43,560 ÷ 21.66, or about 2011 trees. (Planting in a square pattern would accommodate only 43,560 ÷ 25, or about 1742 trees.)

PURPOSE: To estimate population figures based on given growth rates.

LEVEL: Senior High School

SUBJECT(S): Mathematics

REFERENCE: A Sourcebook of Applications of School Mathematics. Mathematics Association of America and National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia 22091, 1980. Reprinted with permission of NCTM.

ACTIVITY:

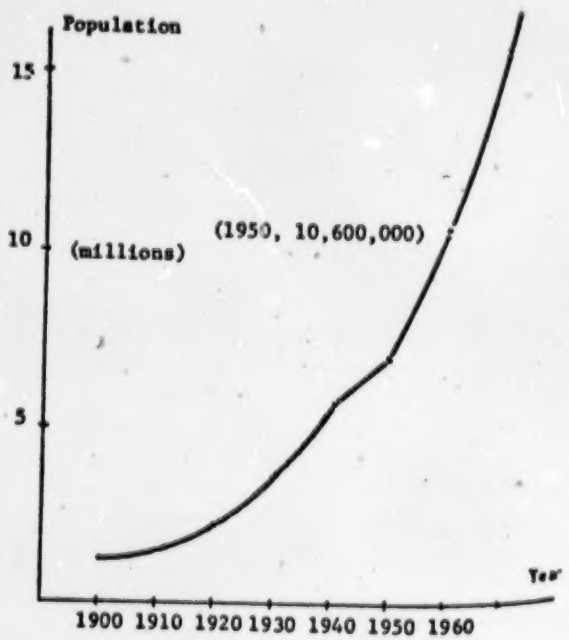
A. Suppose a population grew from x million in 1960 to y million in 1970. Write an expression that will give an estimate for a 1965 population.

B. According to some estimates, the Earth's population will be 7 billion in the year 2000. If it was 4 billion in 1976, estimate the population in 1988.

C. Graphed at right is the population of California every 10 years from 1890 to 1960.

Year	Population
1890	1,213,000
1900	1,485,000
1910	2,378,000
1920	3,427,000
1930	5,677,000
1940	6,907,000
1950	10,586,000
1960	15,717,000

Estimate the population of California (to the nearest 10 thousand) in 1915.



SOLUTION

a. Since 1965 is midway between 1960 and 1970, an estimate could be given by assuming

$$\frac{x}{z} = \frac{z}{y} \qquad \text{Then } z^2 = xy, \text{ and } z = \sqrt{xy}.$$

Comment: This estimate could be compared with actual figures given by an almanac.

b. Let x be the 1988 population. Since 1988 is midway between 1976 and 2000, the same procedure gives 5.3 billion.

c. From the graph, about 3 million; from the table and using the technique of part a, about 2,850,000.

Comment: Here the population doubles about every 20 years.

PURPOSE: To investigate and calculate the amount of energy wasted by automobiles.

LEVEL: Senior High School

SUBJECT(S): Mathematics
Language Arts

REFERENCE: Environmental Education: Energy-Technology: Grades 7-12. New Jersey Council for Environmental Education, 143 Fox Hill Road, Denville, New Jersey 07834. ED 130 822.

ACTIVITY:

Ask your students how much energy is wasted by the automobile. What areas of the automobile waste energy? Make a list of them and check your list with accepted sources. The overall efficiency of the automobile is less than 20 percent. The energy available to the engine of an automobile is equal to the amount of gasoline times the heat of combustion of the gasoline. If 10 gallons of fuel are available and the heat of combustion is 119,000 BTU/gal., how much energy is available to the engine? If the efficiency of conversion is only 20 percent, how much energy is available to power the vehicle? If the average car uses 750 gallons of gasoline a year, how much energy is wasted per year per car? At present there are more than 110,000,000 cars in the United States. How much energy is wasted per year in the United States by automobiles? Present a report to the class. Perhaps a photographic essay would be possible.

LIST OF ACTIVITY REFERENCES

Note: For your convenience, ERIC document numbers are included on all reference materials that are currently available through the ERIC system.

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Unless otherwise noted, these publications are available in both microfiche and hard (paper) copy from Educational Document Reproduction Service (EDRS), and may be located in ERIC microfiche collections. Most are also available in printed form from:

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Exceptions to the above availability statements are noted with individual references. Prices quoted are those of the Information Reference Center (IRC) as of December 1979, and are subject to change. EDRS prices are based on page counts, as indicated in current issues of Resources in Education.

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